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Water Quality and Potential Sediment Erosion Assessment for Proposed Construction at Fort Knox, Kentucky

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Contents

Preface

The work reported herein was conducted for the U.S. Department of the Army, Fort Knox, KY, by the U.S. Army Engineer Research and Development Center (ERDC) under the purview of the Environmental Laboratory (EL) and the Coastal and Hydraulics Laboratory (CHL). Funds for this study were provided under the Military Interdepartmental Purchase Request Number MIPR0KDDK00020.

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Introduction

New training facilities proposed for construction at the Fort Knox Northern Training Complex (NTC) include a digital training range and a complex of drop/landing zones and maneuver area (DLZMA) and are depicted in Figure 1. Three alternatives exist for the digital training range, one at the Yano range, one at the Cedar Creek range, and one at the Wilcox range site. The drop and landing zones and maneuver areas have been proposed for construction near the Mounted Urban Combat Training Area (MUCT) near the Wilcox range site.

Concerns expressed during review of the Environmental Assessments were focused on the potential for adverse impacts to water quality and aquatic resources due to increased sediment erosion associated with construction and subsequent use of these facilities. Consequently, an assessment of the existing water quality and the potential for adverse impacts was conducted for an Environmental Impact Statement (EIS) currently in preparation. The objective of this assessment was to compile and evaluate applicable water quality and flow data for describing existing conditions and evaluating potential impacts associated with the proposed construction. Biological evaluations of aquatic resources have been assessed in separate studies.

Background

Major surface waters in the study area include the Salt River and Rolling Fork River. Smaller tributaries to these two rivers in the area include, Mill Creek, Plum Creek, Wilson Creek, Long Lick Creek, Elm Creek, Brier Creek, Cox Creek, Brooks Run, Floyds Fork, Cedar Creek, and Brushy Fork. Additional small rivers and creeks occur in the area and several lakes and ponds exist including Duck Lake, Wilcox No. 3 Lake, Wilcox Lake, and Pearl Pond, which are in or near the proposed Wilcox site. The small streams are typically sloped from 3 to 7%, with cobble substrate low in areas of accumulation of fine sediment. A more complete description of low order streams and lakes in the study area are provided in Payne and Green (2001). Water supply in the vicinity of Fort Knox and downstream is from groundwater.

The Salt River Watershed is drained by 3,770 miles of rivers and streams but only 650 miles (17%) have been assessed for water quality standards for swimming and fishing. Major pollutant concerns in areas with large populations are related to urban runoff and discharges from wastewater treatment facilities, industries, and septic tanks. Pollutants of concern include bacteria and pathogens, silt, metals, chorine, pesticides, and organic chemicals. In more rural settings, pollutants of concern include silt, animal waste, nutrients and pesticides. Rapid population growth and urban sprawl is a priority concern in the watershed since these activities are major contributors to increased surface runoff and pollutant loading. Since 1990, the population of Bullitt County increased 20-24% and fewer than 50% of the households have access to public treatment facilities. Most of the counties do not have adequate zoning laws or local ordinances or staff to adequately protect water quality (Kentucky Division of Water publication (KDW), 1998). The Lower Salt River watershed begins at Taylorsville Lake Dam and flows to the Ohio River at West Point. Floyds Fork, Rolling Fork, and Cox Creek are major tributaries to the Lower Salt River. The principal land use activity is agriculture (61%) followed by forest (24%), then residential (9%), and urban (5%). The Lower Salt River and its tributaries are located in an area that was historically a swamp. Due to the increased population and changes in land use, this area has flooding and drainage problems (KDW 1998). Soils in the study area have a medium to high potential for sediment runoff, slow to moderate infiltration and can be classified primarily in the McGary, Markland, Lawrence, Garmon, Crider, and Baxter Associations.

Several rivers and streams in the lower Salt River basin have been evaluated for water quality problems (KDW 1998). The Lower Salt River downstream from Shepherdsville is designated as poor but the designation changes to good where the Rolling Fork joins the river. A thorough ecological assessment of the Lower Salt River watershed has not yet been done (KDW 1998). In Bullitt County, the Salt River, Cedar Creek, and Rolling Fork have been classified as impaired for swimming due to pathogens. Cox Creek in Bullitt County has been assessed as having water quality problems, primarily excessive nutrients and siltation and is classified as impaired for aquatic life. Brooks Run in Bullitt County has been classified as impaired for swimming and aquatic life attributed to pathogens and low dissolved oxygen concentrations as a result of organic enrichment. Pennsylvania Run has also been classified as impaired for swimming and aquatic life due to low dissolved oxygen concentrations as a result of organic enrichment. Floyds Fork has also been classified as impaired for swimming and aquatic life due to pathogens, nutrients, and low dissolved oxygen concentrations as a result of organic enrichment. Wilson Creek meets standards for swimming and aquatic life.

In Hardin County, Brushy Fork has been classified as impaired for swimming due to pathogens and Mill Creek has been classified as impaired for aquatic life due to metals, ammonia (unionized), and low dissolved oxygen concentrations as a result of organic enrichment. The Salt River meets standards for swimming and aquatic life in Hardin County. There has not been a similar water quality evaluation of the Rolling Fork River.

General Description of Proposed Sites

Cedar Creek Range – Utilization of this site would require extensive excavation of adjacent hills and likely result in considerable increase in sediment erosion. The site is approximately 12.5 miles from the Mounted Urban Combat Training Area (MUCT) and the proposed drop/landing zones and maneuver area (DLZMA), with no direct route available through Fort Knox territory. To get to the MUCT, tanks would have to be hauled off post and through congested areas or a new road would have to be established on the post. Building an on-post road is possible but would require transiting an impact area. Potential environmental impacts related to vegetation removal and increased sediment erosion would likely be caused by on-post road construction to connect the Cedar Creek range to the MUCT.

Yano Range – This site could be modified to include the digital training range with minimal environmental impacts. The site is approximately 12.5 miles from the MUCT and proposed DLZMA, with no direct route available through the Fort Knox territory. As required for the Cedar Creek Range, to get to the MUCT and proposed DLZMA, tanks would have to be hauled off post and through congested areas or a new road would have to be established on the post. Building an on-post road is possible but would require transiting an impact area. Potential environmental impacts related to vegetation removal and increased sediment erosion would likely be caused by on-post road construction to connect the Yano range to the MUCT and proposed DLZMA.

Wilcox Range - Utilization of this site would require extensive clearing of forested areas that include wetlands and lakes. The area also contains habitat for endangered species that would be adversely impacted. Potential environmental impacts include increased sediment erosion, loss of habitat, and loss of wetlands. This site is located closest (1-3 mi) to the MUCT and proposed DLZMA and would require much less construction to be connected than the Cedar Creek or Yano ranges.

The DLZMA (Areas 1-5, and 9) contain approximately 1,171 acres. The vast majority of this land is forested. There are numerous sinkholes associated with the karst topography in the area that would possibly receive runoff and sediments associated with construction of the DLZMA. Removal of forest vegetation to accommodate training needs associated with the DLZMA will potentially increase runoff and sediment/material transport, particularly during construction. Establishment of buffer zones has been proposed to reduce the impact of materials transported with runoff to the sinkholes and nearby surface waters.

Methods

Discharge information on area creeks, streams, and rivers was retrieved from the US Geological Survey (USGS) water resources website (http://waterdata.usgs.gov/nwis-w/KY/) and from the US Army Engineer District in Louisville, KY. Water quality data were retrieved from the US Environmental Protection Agency (EPA) database (Storage and Retrieval System (STORET)), and requested from the Kentucky Department of Environmental Protection (KDEP), Division of Water and the Fort Knox database for the Kentucky Pollutant Discharge Elimination System (KPDES) permit for the facility. Water quality data for the city of West Point, which is near the confluence of the Salt River and the Ohio River, was included in the retrieval from STORET.

Discharge data for the two major rivers in the study area (the Salt River and Rolling Fork River) were plotted and general temporal trends were described. Water quality values of selected chemical constituents collected by the KDEP were compared for both rivers and general temporal trends were described. Estimates of annual loads of total nonfilterable residue (TNFR), or suspended solids, were calculated with discharge data for the Salt River at Shepherdsville, KY and the Rolling Fork River at Boston, KY and TNFR data collected monthly in the period from October 1995 to December 1998 by the KDEP. Water quality data from other sources had limited recently collected data and consequently were tabulated for subsequent discussion. A suite of regression models (FLUX) developed by Walker (1996) was used to calculate the estimates of TNFR loads for each river. Use of FLUX provides statistical comparisons of six different regression techniques to determine the best fit for the data and stratification of flow to improve the fit of the data to the least variable model. These estimates were then compared to estimates of sediment yield for the proposed construction at each potential site.

Sediment yield for the various training areas was computed using the Revised Universal Soil Loss Equation (RUSLE). This equation uses data derived from local rainfall intensity, frequency, soil types, vegetative cover and conservation practices. The RUSLE equation is given below.

$$A = R*K*L*S*C*P$$

Where

A = Annual sediment yield in tons per acre per year
R = Rainfall erosivity factor
K = Soil erodibility factor
L = Length of field (sub-area)
S = Slope of field (sub-area)
C = Crop or canopy cover factor
P = Conservation practice factor

The sediment yield for each training area in the Northern Training Complex was computed for three conditions; existing conditions, conditions during construction, and post-construction conditions. Table 1 lists the values used for each factor in the RUSLE equation for each condition.

The "R" value was determined from Yang (1996, Figure 8.1). The "K" factor was determined based on soil types in the area. The U. S. Department of Agriculture report "Soil Survey of Bullitt and Spencer Counties, Kentucky" was consulted. The predominant soil type in the area for the hillsides is Garmon-Crider, a well-drained loam soil. For the valley areas, the soil type adopted was McGary-Markland, poor to well drained soils with a clayey subsoil. For the Garmon-Grider soils, a value of 0.34 was assigned. For the McGary-Markland soils, a value of 0.29 was assigned. The LS factor was computed based on a formula provided by Yang (1996, Formula 8.2). The cropping or canopy factor used was 0.004 for existing and long-term conditions. This value has been used for established grass meadows as reported in Yang (1996). During construction, the C factor used was 0.70. The conservation practice factor was assumed to be 1.0 for existing and construction conditions. This assumes no contouring. For the long-term condition, this factor was assumed to be 0.80 allowing for some contouring after construction was complete.

The digital terrain elevation data for the Fort Knox area was obtained from the U. S. Geological Survey website for 1:24000 scale map data. The training areas were plotted onto this digital representation of the Fort Knox training areas. Using ARCVIEW, the training areas were superimposed over the digital data grid. This resulted in cells thirty meters on a side comprising the training areas. Using ARCVIEW and the above equations and assigned values, parameters were developed for each cell comprising each training area. The larger areas comprised some 5,500 cells each. The RUSLE equation was then applied to each cell within each training area. Total sediment yield, on an annual basis, was then calculated for each training area for each of the three conditions. Visual analysis of the training area locations and the topographic map allowed the sediment from each area to be assigned to a receiving stream (Table 2).

Results

Discharge data for rivers in the area are presented in Table 3. Although the drainage area for the Salt River at Shepherdsville is about 100 mi^2 less than that for the Rolling Fork River, discharges are comparable (Figures 2 and 3). Major peak flows occur between December and May but summer and/or fall rain events were observed in 1995, 1996, and 1997 in both rivers. Operation of the dam at Taylorsville Lake on the Salt River provides water management and a less variable flow downstream during rain events. Nearly 40-45% of the flow occurs at a discharge of less than 500 ft^3 sec^{-1} for both rivers and the distribution between ranges for each river is comparable (Figure 4). Other rivers and streams in the study area, although responsive to rain events, provide much lower discharge (e.g., mostly less than 500 ft^3 sec^{-1}, Table 3).

Data retrieved from STORET was mostly for infrequent sampling of wells and limited sampling of surface water sites. Most of the data were collected in the period from 1980 to 1982. Maximum and minimum values are reported in Appendix A. Notable high values included concentrations for total phosphorus and dissolved orthophosphorus in an unnamed tributary to Mill Creek, total and dissolved calcium in a spring, total magnesium and sodium in an unnamed tributary to the Salt River, and total aluminum in the water and sediment in the Salt River upstream from Pond Creek and associated with a discharge from a pipe.

General water quality conditions were best described with recently collected data for the Salt River at Shepherdsville and the Rolling Fork River at Boston by the KDEP (Appendix B) and are summarized in Table 4. Similar temperatures were observed at both sites (Figure 5) ranging from near 0 ^{O}C in the winter to near 28 ^{O}C in the summer. Dissolved oxygen concentrations were also similar between sites and displayed seasonal trends as well (Figure 6). Maximum values, near 12-13 mg L^{-1} were observed in the winter and lower values, near 5-6 mg L^{-1} were observed during the summer in August. A concentration near 12 mg L^{-1} was observed in August indicating that daily primary productivity could result in higher concentrations in the summer. The time of sample collection would influence observations since dissolved oxygen is typically dynamic on a daily cycle with lower concentrations occurring in the early morning and maximum concentrations occurring in the afternoon. Total nonfilterable residue concentrations were mostly below 100 mg L^{-1} for both sites and increased concentrations were more common for the Rolling Fork River with maximum concentrations exceeding 800 mg L^{-1} on two occasions coincident with storm events (Figure 7). Dampened or lower concentrations would be expected on the Salt River since the dam at Taylorsville Lake attenuates upstream flows associated with major rainfall events and also likely acts as a trap for sediment deposition. Total organic carbon concentrations ranged mostly from near 2 to near 5 mg L^{-1} and were generally lower in the Rolling Fork River except for during major runoff events when concentrations approached 10 mg L^{-1} (Figure 8). Conductivity values ranged from 230 to 550 µmhos cm^{-1} with maximum values occurring in the late summer and in association with major runoff events (Figure 9). Mean conductivity values were near 380 to 400 µmhos $^{-1}$. Values were slightly higher in the Salt River most of the period of observation. Total alkalinity concentrations ranged between 50 and 200 mg L^{-1} as $CaCO_3$ and, in general, were similar at the two sites (Figure 10). Total Kjeldahl nitrogen concentrations were between 0.2 and 1.0 mg L^{-1} except for during runoff events in the Rolling Fork River basin and a major runoff event in both basins in 1998 when concentrations approached 2 mg L^{-1} (Figure 11). Mean values for total Kjeldahl nitrogen were near 0.8 mg L^{-1}. Total phosphorus concentrations were highly variable and ranged from 0.01 to 0.50 mg L^{-1}, with values above 0.35 mg L^{-1} coincident with major runoff events (Figure 12). Elevated values (e.g., > 0.20 mg L^{-1}) were observed for both basins but not always coincidentally. Mean values of total phosphorus were near 0.17 mg L^{-1}. Total chloride values ranged between 2 and 40 mg L^{-1} and were generally slightly higher in the Salt River with a maximum value occurring in 1998 coincident with a major runoff event (Figure 13). Concentrations in the Salt River were generally higher than in the Rolling Fork River. Dissolved sulfate concentrations ranged from 6 to 60 mg L^{-1} and were similar between sites with the exception of higher concentrations in the Rolling Fork River in June of 1997 and in the Salt River in August of 1997 (Figure 14). Total aluminum concentrations were mostly below 2,000 µg L^{-1} at both sites with exceptions primarily in the Rolling Fork River 3 times in 1996 and 1 time in 1997 and 1998 when concentrations exceeded 4,000 µg L^{-1} and 10,000 µg L^{-1} (Figure 15). Total iron concentrations were mostly below 2,000 µg L^{-1} with values greater than 5,000 µg L^{-1} occurring primarily in the Rolling Fork River coincident with runoff events (Figure 16). As was observed for total aluminum concentrations, elevated concentrations (e.g., > 20,000 µg L^{-1} were observed in 1996 and 1998 coincident with major runoff events in the Rolling Fork River basin. Fecal coliform concentrations were mostly low (e.g., < 2,000 counts ml^{-1}) but elevated concentrations were observed in the Salt River coincident with runoff events in 1996 and 1998 (Figure 17).

Heavy metals are also monitored at the KPDES sites and concentration ranges for 1997 to November of 1999 are reported in Table 5. Concentrations were mostly near or below the

detection limit for most constituents and elevated concentrations were not observed for any constituent. Selected outfalls were also monitored for total suspended solids, hardness, pH, oil and grease, and chlorides and results are summarized in Table 6. Concentrations of total suspended solids were below or near the mean value of total nonfilterable residue for the Salt River. In general, reported concentrations were within acceptable limits.

Water quality was sampled in Mill Creek by the Kentucky Department for Environmental Protection (KDEP) at three stations in May of 1982 in Hardin County. Minimum and maximum values for selected constituents are presented in Table 7. In general, conductivity, chloride, and sulfate were high and variable and likely contribute to elevated and variable total dissolved solids. The water could be considered as hard based on alkalinity measurements. Values for pH were near neutral. Nutrient concentrations (nitrogen species and phosphorus) were also elevated and quite variable. Chemical oxygen demand was occasionally high. Suspended solids concentrations were low to moderate and, consequently, the turbidity was relatively low. The study concluded that the major impact to the stream is the discharge of domestic wastewater, which has affected the aquatic life in portions of the stream. Violations of Kentucky Surface Water Standards were observed for free cyanide, undissociated hydrogen sulfide, phthalate esters, unionized ammonia, aluminum, and iron (KDEP 1984). Nutrient levels were greatest at the downstream sites. Low dissolved oxygen (DO) values were observed at the downstream sites and were considered to indicate that diurnal and/or seasonal violations of water quality standards for DO are likely to occur. Sediment data showed only pentachlorophenol above detection limits and arsenic was the only metal with a concentration that could be considered as elevated and indicative of pollution. Biological communities downstream from the Radcliff Wastewater Treatment Plant (WWTP) discharge were drastically reduced in diversity when compared to communities upstream from the WWTP. Upstream communities consisted of typical stream forms while downstream communities were dominated by species tolerant to organic and nutrient enrichment. The stream supports a moderate sport fishery. Recommendations included designation for aquatic life/warmwater aquatic habitat and primary and secondary contact recreation. It was recommended that public use should be avoided due to limited access and potentially dangerous military ordinances.

Results of estimates for loading of total nonfilterable residue using regression analysis provided by FLUX are included in Appendix C and summarized in Table 8. In general, individual regression methods resulted in similar loading estimates between $1 * 10^8$ and $6 * 10^8$ kg year^{-1} (110,250 and 661,500 tons year^{-1}). Variances were relatively high indicating a need for sampling optimization to better describe concentrations during runoff events. Stratification of the hydrograph for low flow and high flow levels of discharge did not considerably reduce the variance.

Sediment yields for existing, during construction, and long-term conditions for each training area are summarized in Table 9. As would be expected, maximum sediment yield occurs coincident with construction. The highest sediment yield during construction was estimated for Area 12, Cedar Creek range and then by Area 6, the Wilcox site, followed by Area 1 and Area 11, the Yano Range. The number of acres for the Wilcox range seems high. However, the number of acres were determined by draping files provided by Fort Knox personnel over the digital terrain map. Interestingly, the greater acreage at the Wilcox site did not yield the highest sediment load, and was half of the estimate for the Cedar Creek range. This may be attributed to increased removal of material required for the Cedar Creek range and a greater change in topography than exists at the Wilcox site. An analysis of the topography for each range provides the explanation. The Cedar Creek range measures about 1,250 acres. However, 31% of the area in this range has a surface slope of more than 10%. This compares to

15% of the Yano range area and 9% of the Wilcox range having a surface slope of greater than 10%. In addition, the areas with a high slope also have a higher erodibility factor, "K", based on the soil type. Therefore, the higher slope and erodibility increase sediment yield. The yield for Wilcox is high due to the slope being only a little less than that for the Yano range, but the area is 22% larger, as included in this analysis.

Construction of the larger ranges (Yano, Wilcox, Cedar Creek) will result is some filling in the adjacent floodplains. Detailed evaluation, at this stage of the planning, has not been conducted for inclusion in this report. However, some qualitative opinions may be put forth. If floodplain encroachment is of limited length, even if the fill is quite high, then such encroachments do not significantly raise flowlines for high stream flows. When the encroachment is for extended length, even if of modest height, the flowline is likely to be raised considerably. These effects will extend for some distance, depending on the stream slope, width and flow rate, upstream from the encroachment. The result is that flooding will be induced upstream of such encroachments. Detailed construction plans were not analyzed for this study. A cursory evaluation would qualitatively indicate that the Cedar Creek range will not significantly affect Rolling Fork flow lines. However, the tributaries transecting the range may well be affected. Yano Range construction would be expected to have some effect on Rolling Fork flow lines, if the floodplain is raised significantly. Since the Wilcox range is largely already in place, no adverse effects would be expected from improvements to this range on Upper Salt River flowlines.

Potential impacts to water quality include increased runoff of sediments and nutrients, increased temperatures of surface waters, increased runoff of oil and grease associated with increased vehicle traffic. The major period of impact will occur coincident with construction but can be minimized with the use of required best management techniques. There is no conversion factor available to determine the potential increase in suspended solids concentrations associated with increased sediment loading, but concentrations periodically greater than 100 to 200 mg L^{-1} in the Salt River and Rolling Fork River, respectively, have been observed coincident with runoff events and provide an upper boundary for existing conditions (Figure 7). Increased suspended solids concentrations would likely be confined to the period of construction and continue at lower values while revegetation occurred. Upon complete re-establishment of vegetation, sediment loading to the streams should be near pre-construction levels (Table 9). Areas that drain to the Lower Salt River have a higher potential for adverse impacts associated with sediment loading than areas that drain to the Rolling Fork River since concentrations in the Salt River are typically lower which is considered to be favorable to aquatic life and water quality. While hourly data for temperature was not available to evaluate maximum daily values, temperatures were remarkably consistent between the Salt River and Rolling Fork River, and maximum observed values were between 25 and 28 ^{O}C (Figure 5). Instantaneous and time-averaged (e.g., daily, weekly, monthly, etc.) maximum values would also be expected to increase with a greater solar input if clearing is conducted in close proximity to the streams and lakes. It is difficult to predict the increase in temperature, especially for each site, but increases between 3.3 and 10.5 ^{O}C in the average monthly temperature following clear-cutting have been reported (Kochenderfer and Aubertin 1975; Rishel et al. 1982; and Swift, Jr. and Messer 1971). It is likely that the areas that require the most clearing along streams and lakes (e.g., the Wilcox site) will be the most susceptible to increased water temperatures. Increased runoff from oil and grease would likely be the same at each site with differences in actual input to the stream as a function of topography, proximity of roads and parking areas, and implementation of best management practices. Evaluation of KPDES permit data indicate that current practices do not result in excessive concentrations of oil and grease under existing conditions.

The use of buffer zones and maintenance of riparian areas along streams and sinkholes has been recommended and specific guidance has been provided by state agencies. These zones help regulate light and temperature to the streams, provide nutrients to the terrestrial and aquatic community, are a source of woody debris to the streams which impacts velocity and sedimentation patterns, and regulate the flow of water and materials (e.g., nutrients and sediments) for upland areas (Naiman et al. 1993). Implementation of best management practices, such as maintenance of buffer strips, prohibition of skidding over streams, proper road location, and avoidance of logging during prolonged wet periods and replanting of cleared areas during clearing can greatly reduce sediment transport to the nearby streams (Lynch et al. 1985). Castelle et al. (1994) suggest that a buffer zone should have a minimum width of 15 m to be effective at protecting wetlands and streams under most conditions, however a range of 3 to 200 m was found to be most effective with temperature moderation requiring 10 – 30 m, sediment removal requiring 10 – 60 m, and nutrient removal requiring 10 – 100 m. Certainly these widths will vary with site-specific conditions.

Summary

Water quality data recently collected by the KDEP at the Salt River near Shepherdsville, KY and the Rolling Fork River and by Fort Knox personnel on site, as required by the KPDES permit, provide information for describing general water quality conditions of surface waters in the study area. Observed ranges of temperature, dissolved oxygen, and pH are typical for rivers and streams in the area and indicated seasonal patterns that would be expected. Sampling limited to once per day precluded assessment of daily cycles. Concentration ranges for most of the constituents monitored were indicative of hard water surface waters (e.g., high ranges of conductivity, total alkalinity, chloride, sulfate). While total Kjeldahl nitrogen concentrations were generally low (e.g. < 2 mg L^{-1}), total phosphorus values were well above concentrations of 0.02 mg L^{-1} that are indicative of eutrophic conditions in lakes and reservoirs. However, total organic carbon concentrations near 5 mg L^{-1} are common in streams and rivers with forested areas in the watershed and are not typically considered to be excessively high concentrations. Concentrations of nonfilterable residue, total iron, and total aluminum were also not typically high, except for during runoff events. Fecal coliform concentrations were generally at acceptable limits for designated uses. Temporal patterns in concentration distributions indicated that elevated concentrations were coincident with selected runoff events and that spatial differences between the 2 sites were minimal except for a few runoff events, which likely occurred differently at each site (e.g., less intense rainfall or localized rainfall at one site). Comparison of recently collected data to data collected in 1982 at Mill Creek suggests that water quality has likely improved since considerably fewer violations are occurring. Loading estimates for total nonfilterable residue indicated that sediment loads in the Salt River at Shepherdsville (near 105,000 to 179,000 tons $year^{-1}$) were about four times lower than for the Rolling Fork River (near 550,00 to 723,000 tons $year^{-1}$).

Estimates of sediment yield were highest for the construction period (as would be expected) but accounted for less than 0.2% of the annual load from each training area to the corresponding receiving stream using existing and post-construction conditions (Table 9). During construction, increased sediment accounted for 4 to 8% of the annual load at all sites except for Area 1 (27.5%), Area 6 or the Wilcox site (40.1%), and Area 12 or the Cedar Creek range (21.5%). The extremely high yields during construction are deceiving. These are based on no conservation practices during construction such as the erection of sediment barriers, hay bale

dams and construction of temporary berms to prevent sediment from leaving the construction site. The construction specifications will undoubtedly call for such measures. Also, these figures are based on annual yield. Again, the actual construction period may be only a few months in length, or the site may be constructed in phases so that smaller areas are disturbed at any one time. Barring a catastrophic failure, the actual sediment loss from the site should be much less with conservation practices in place during construction. An increase over the existing sediment yield may be on the order of 150-200%.

Estimates of annual sediment yields during construction could account for a considerable part of the total annual sediment load to the Rolling Fork and Salt River, however, implementation of best management practices, adjustment of annual sediment yields to a projected length of construction, and construction during periods of minimum rainfall would greatly reduce the sediment load associated with runoff. Using the increase in the percent of the annual sediment load indicates that construction at the Wilcox site will have the most measurable impact on water quality followed by Area 1 and the Cedar Creek range.

Recommendations to provide considerable reductions in potential adverse impacts on water quality associated with construction and utilization of the completed project include maintenance of buffer zones and implementation of best management practices during construction. Construction should be scheduled, if possible, to avoid periods when rainfall events normally occur to minimize transport of material from the watershed to the streams and rivers with runoff.

Table 1. Values used in the Revised Universal Soil Loss Equation.

Factor	Existing	Construction Period	Post-construction
R	195	195	195
K	(0.34 for hill areas, 0.29 for valley areas)	(0.34 for hill areas, 0.29 for valley areas)	(0.34 for hill areas, 0.29 for valley areas)
LS	Computed for each sub area	Computed for each sub area	Computed for each sub area
C	0.004	0.70	0.004
P	1.0	1.0	0.80

Table 2. Training areas and associated receiving streams.

Training Area	Receiving Stream
1	Lower Salt River
2	Lower Salt River
3	Lower Salt River
4	Lower Salt River
5	Lower Salt River
6	Upper Salt River
9	Upper/Lower Salt River
10	Lower Salt River
11	Rolling Fork River
12	Cedar Creek/Rolling Fork River

Table 3. Summary of available discharge data for the Fort Knox area.

River or Stream	USGS Station ID	Drainage Area (miles^2)	Comments (average or range of flow)
Salt River at Shepherdsville, KY	03298500	1197	Retrieved 1990-1999 (1700 ft^3 sec^{-1})
Rolling Fork at Boston, KY	03301500	1299	Retrieved 1995-1999 (1800 ft^3 sec^{-1})
Rolling Fork Near Lebanon, KY	03299000	239	1990-1992 only (2000-5000 ft^3 sec^{-1})
Mill Creek Near Fort Knox, KY	03301700	38.2	1999 only (<200 ft^3 sec^{-1})
Plum Creek Near Wilsonville, KY	03296500	19.1	1955-1961 (<700 ft^3 sec^{-1})
Wilson Creek Near Deatsville, KY	03301580	27.7	1991-1996 (<200 ft^3 sec^{-1})
Long Lick at Clermont, KY	03298550	7.91	1992-1999 (<200 ft^3 sec^{-1})
Elm Lick Near Clermont, KY	03298535	0.68	1975-1985 Peak Flow only (50-800 ft^3 sec^{-1})
Brier Creek at Pendelton Road	03302050	n/a	1999 (10-40 ft^3 sec^{-1})

Table 4. Summary statistics for the KDEP water quality data (1995-1998).

Salt River															
	WATER	CNDUCTVY	DO	PH	T ALK	CHLORIDE	SULFATE	RESIDUE	T ORG C	TOT HARD	NH3+NH4-	NO2&NO3	TOT KJ	PHOS-T	FEC COLI
	TEMP	FIELD			CACO3	TOTAL	S04-DISS	TOT NFLT	C	CACO3	N TOTAL	N-TOTAL	N		MFM-FCBR
	CENT	MICROMHO	MG/L	SU	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L P	/100ML
Mean	13.5636	404.727273	9.009	7.648	142.68	11.857143	28.07429	50.08571	4.131429	177.45714	0.0576	1.0117143	0.6658	0.16477	1867.5
Std. Dev.	7.58769	62.1310474	2.595	0.245	29.626	7.0841283	13.74286	69.45772	1.303789	44.284072	0.0219628	0.4462292	0.311	0.09537	3573.40827
Std. Err.	1.32085	10.8156271	0.459	0.044	5.0808	1.1974362	2.322967	11.7405	0.220381	7.4853743	0.0037124	0.0754265	0.0526	0.01612	893.352068
Min	0.4	265	4.7	7	49	3	10	1	2.2	11	0.05	0.11	0.159	0.018	10
Max	27.7	554	13.1	8.1	188	41	58.6	382	9.9	235	0.166	2.02	1.8	0.431	12000
n	33	33	32	31	34	35	35	35	35	35	35	35	35	35	16
Rolling Fork Near Lebanon Junction	10	94	300	400	410	940	946	530	680	900	610	630	625	665	31616
	WATER	CNDUCTVY	DO	PH	T ALK	CHLORIDE	SULFATE	RESIDUE	T ORG C	TOT HARD	NH3+NH4-	NO2&NO3	TOT KJ	PHOS-T	FEC COLI
	TEMP	FIELD			CACO3	TOTAL	S04-DISS	TOT NFLT	C	CACO3	N TOTAL	N-TOTAL	N		MFM-FCBR
	CENT	MICROMHO	MG/L	SU	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L P	/100ML
Mean	13.7581	379.032258	8.855	7.597	142.12	7.2571429	32.79429	218.4	3.817647	185.11429	0.0598286	0.798	0.7645	0.15751	384
Std. Dev.	7.58524	62.3685198	2.332	0.194	30.42	4.3679505	14.02808	643.1444	1.850712	34.70868	0.0287172	0.4870367	0.4707	0.14041	470.33119
Std. Err.	1.36235	11.2017168	0.419	0.036	5.217	0.7383184	2.371178	108.7112	0.317394	5.8668376	0.0048541	0.0823242	0.0796	0.02373	121.438991
Min	1.4	236	5.5	7.1	72	2	6	1	1.3	104	0.05	0.05	0.175	0.01	30
Max	26.6	510	13.3	8	202	23	61.2	3800	9.9	255	0.201	1.94	1.99	0.534	1400
n	31	31	31	29	34	35	35	35	34	35	35	35	35	35	15

Table 4. Summary statistics for the KDEP water quality data (1995-1998).

Salt River														
	ALUMINUM	ARSENIC	CADMIUM	CHROMIUM	COPPER	IRON	LEAD	MANGNESE	MERCURY	ZINC	CALCIUM	MGNSIUM	PTSSIUM	SODIUM
	AL,TOT	AS,TOT	CD,TOT	CR,TOT	CU,TOT	FE,TOT	PB,TOT	MN	HG,TOTAL	ZN,TOT	CA-TOT	MG,TOT	K,TOT	NA,TOT
	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	MG/L	MG/L	MG/L	MG/L
Mean	986.4	2.028571	1	1.82857143	1.942857	1534.5	2.42857	200.1142857	0.0742857	6.0286	56.01143	10.348571	3.196857	6.94543
Std. Dev.	912.027709	0.169031	0	1.38236188	1.714006	1373.1	1.03713	460.9711469	0.0253546	6.2095	10.62073	2.5129513	0.906596	3.3684
Std. Err.	154.16082	0.028571	0	0.23366181	0.28972	232.09	0.17531	77.91834523	0.0042857	1.0496	1.795231	0.4247663	0.153243	0.56936
Min	102	2	1	1	1	209	2	27	0.05	2	19	5.5	2.14	2.73
Max	4280	3	1	6	9	6270	7	2810	0.1	36	71.7	14.8	6.24	17.3
n	35	35	35	35	35	35	35	35	35	35	35	35	35	35
Rolling Fork Near Lebanon Junction	1105	1002	1027	1034	1042	1045	1051	1055	71900	1092	916	927	937	929
	ALUMINUM	ARSENIC	CADMIUM	CHROMIUM	COPPER	IRON	LEAD	MANGNESE	MERCURY	ZINC	CALCIUM	MGNSIUM	PTSSIUM	SODIUM
	AL,TOT	AS,TOT	CD,TOT	CR,TOT	CU,TOT	FE,TOT	PB,TOT	MN	HG,TOTAL	ZN,TOT	CA-TOT	MG,TOT	K,TOT	NA,TOT
	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	MG/L	MG/L	MG/L	MG/L
Mean	2071.17143	2.2	1	2.57142857	2.971429	3990.3	3.57143	166.7428571	0.0728571	11.286	54.15143	12.12	2.958571	4.95457
Std. Dev.	2657.14744	0.719477	0	2.17317488	2.628864	5248.1	2.95342	137.662277	0.0252716	13.073	9.724662	2.9570255	0.762516	2.79939
Std. Err.	449.139892	0.121614	0	0.3673336	0.444359	887.09	0.49922	23.26917183	0.0042717	2.2098	1.643768	0.4998285	0.128889	0.47318
Min	191	2	1	1	1	604	2	44	0.05	2	31.9	5.9	1.79	1.37
Max	10800	6	1	8	13	22300	17	599	0.1	55	73.2	18.1	4.19	15.2
n	35	35	35	35	35	35	35	35	35	35	35	35	35	35

Table 5. Concentration ranges for selected heavy metals and mercury at the KPDES monitoring sites for the Fort Knox facility (1997-1999).

Constituent (mg L^{-1})	Minimum	Maximum
T. Cadmium	BDL	0.0006
T. Chromium	0.001	0.036
T. Copper	BDL	0.018
T. Lead	0.002	0.072
T. Mercury	0.0001	0.0009
T. Silver	BDL	0.002
T. Nickel	0.003	0.027
T. Zinc	0.001	0.049
PH (standard units)	7.4	8.8

Table 6. Reported discharge and proposed limits for selected water quality constituents at selected outfalls on Fort Knox (1997 Permit).

Constituent	Reported Discharge	Reported Discharge	Proposed Limits	Proposed Limits
	Monthly Average	Daily Maximum	Monthly Average	Daily Maximum
Outfall 003				
Flow (MGD) *	27.2	42	Report	Report
Total Suspended Solids (mg L^{-1})	11.4	36	Report	Report
Hardness (as mg L^{-1} $CaCO_3$)	210	225	Report	Report
pH (standard units)	7.9 (min)	8.0	Report	Report
Outfall 004				
Flow (MGD)	30.4	43	Report	Report
Total Suspended Solids (mg L^{-1})	12.3	47	Report	Report
Hardness (as mg L^{-1} $CaCO_3$)	206	215	Report	Report
pH (standard units)	7.9 (min)	8.0	Report	Report
Outfall 005				
Flow (MGD)	38	58	Report	Report
Total Suspended Solids (mg L^{-1})	12.8	56	Report	Report
Hardness (as mg L^{-1} $CaCO_3$)	203	210	Report	Report
pH (standard units)	7.9 (min)	8.0	Report	Report
Outfall 006				
Flow (MGD)	47.8	65	Report	Report
Total Suspended Solids (mg L^{-1})	12.3	50	Report	Report
Hardness (as mg L^{-1} $CaCO_3$)	203	210	Report	Report
pH (standard units)	7.9 (min)	8.1	Report	Report
Outfall 017				
Discharge Flow (MGD)	0.0005	0.0005	Report	Report
Salt River Flow (MGD)	1,544	2,921	Report	Report
Total Suspended Solids (mg L^{-1})	92.3	387	30	60
Oil and Grease (mg L^{-1})	3.2	4.0	10	15
pH (standard units)	7.3 (min)	7.7	6.0 (min)	9.0
Discharge Chlorides (mg L^{-1})	39,522	42,000	Report	Report

* MGD = million gallons per day

Table 7. Range of selected chemical constituent concentrations from Mill Creek, KY (1982).

Constituent	Minimum	Maximum
Conductivity (µmhos cm^{-1})	429	1043
pH (standard units)	7.0	7.8
Dissolved Oxygen (mg L^{-1})	4.0	7.6
BOD_5 (mg L^{-1})	1.4	7.7
COD (mg L^{-1})	2.9	37.0
Alkalinity (mg L^{-1})	152.0	159.2
Chloride (mg L^{-1})	12.3	143.2
Turbidity (NTUs)	6.2	6.5
Total Dissolved Solids (mg L^{-1})	262	600
Suspended Solids (mg L^{-1})	4.0	38.0
Sulfate (mg L^{-1})	51.9	102.4
NH_3-N (mg L^{-1})	0.13	7.34
$NO_2 + NO_3$-N (mg L^{-1})	0.345	4.4
TKN (mg L^{-1})	0.59	7.64
Total Phosphorus (mg L^{-1})	0.05	8.4
Dissolved Orthophosphorus (mg L^{-1})	0.006	7.8
Total Aluminum (µg L^{-1})	292	1250
Dissolved Aluminum (µg L^{-1})	131	292
Total Iron (µg L^{-1})	190	1156
Dissolved Iron (µg L^{-1})	15	52

Table 8. Estimated loading of total nonfilterable residue for Salt River and Rolling Fork River.

	Salt River	Rolling Fork
Average Flow (ft^3 sec^{-1})	1711	1840
FLUX (Flow Weighted Avg Conc) (*Kg $year^{-1}$) (** tons $year^{-1}$)	* 1.626×10^8 ** 179,266.5	* 6.556×10^8 ** 722,799
Estimated Load (Avg Conc * Avg Flow) (*Kg $year^{-1}$) (** tons $year^{-1}$)	* 0.960×10^8 ** 105,840	* 4.999×10^8 ** 551,139.8

Table 9. Annual sediment yield for the training sites for existing, construction, and post-construction conditions.

Training Area	Designation	Existing (tons/yr)	% load	Construction (tons/yr)	% load	Long term (tons/year)	% load	Acres*
Area1		225	0.158	39360	27.611	180	0.126	541
Area2		43	0.030	7575	5.313	35	0.024	108
Area3		73	0.051	12843	9.009	59	0.041	220
Area4		64	0.045	11198	7.856	51	0.036	131
Area5		35	0.024	6038	4.236	28	0.019	81
Area6	Wilcox	328	0.230	57467	40.312	328	0.230	1509
Area9		63	0.044	11060	7.759	51	0.035	93
Area10		37	0.026	6396	4.487	29	0.021	265
Area11	Yano	220	0.035	38499	6.044	176	0.028	1234
Area12	Cedar Crk	784	0.123	137160	21.533	627	0.098	1225
Notes								
*	As computed for sediment yield calculations							
**	Annual yield, should be adjusted based on projected length of construction							

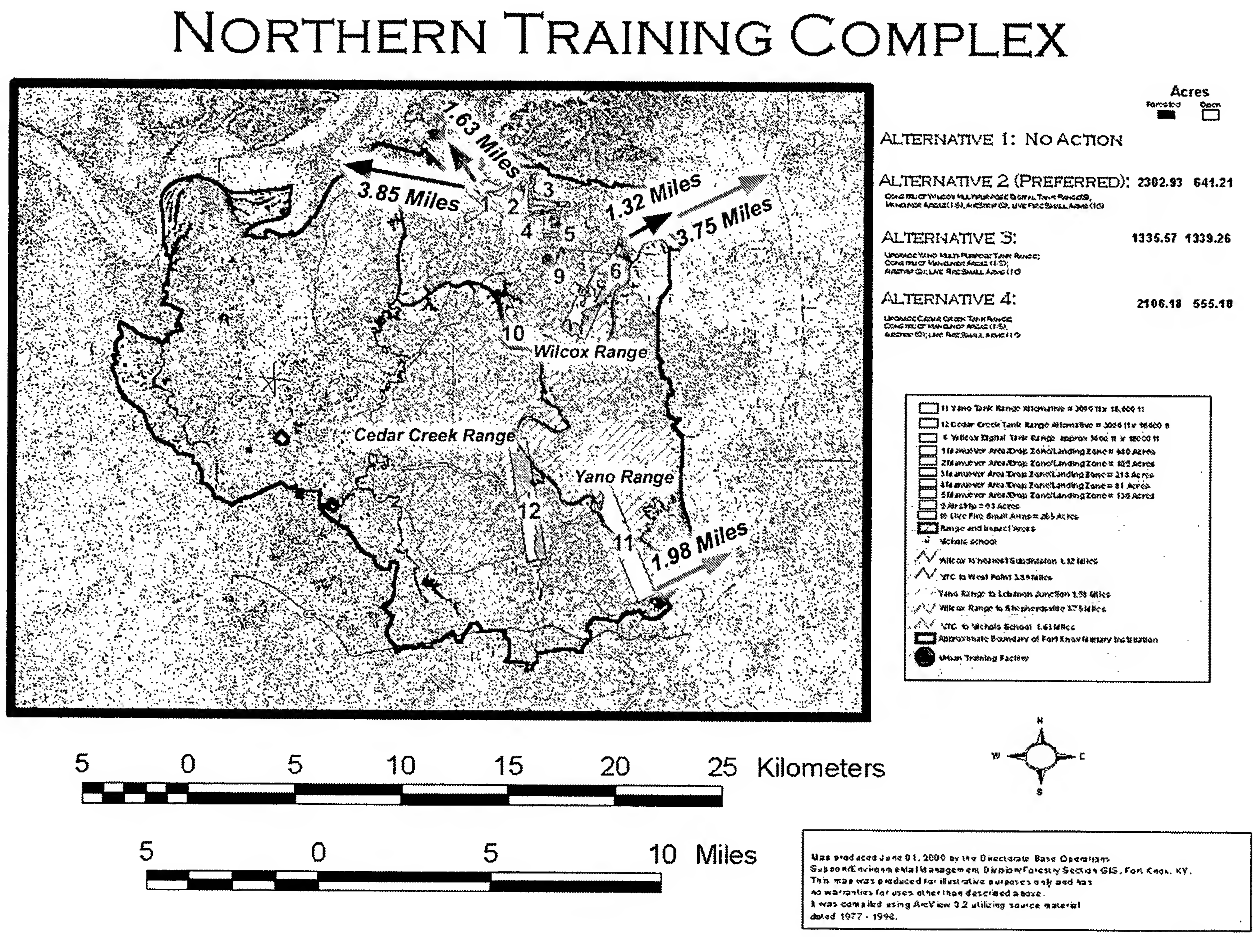

Figure 1. Proposed training sites for the Northern Training Complex.

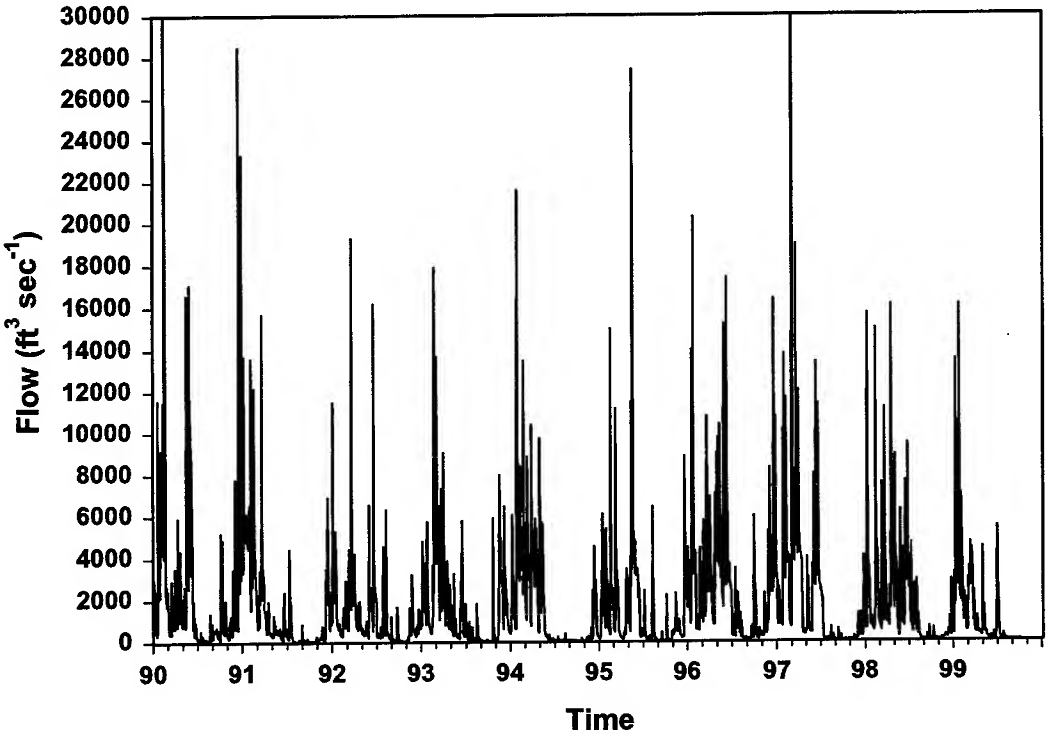

Figure 2. Discharge for the Salt River at Shepherdsville, KY, 1990-1999.

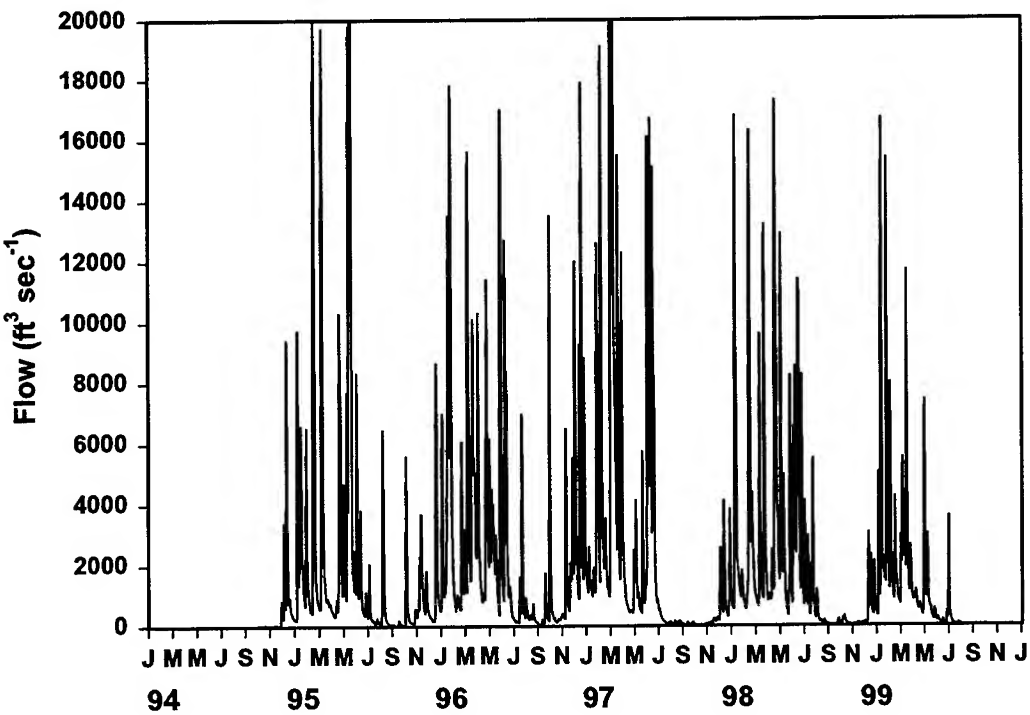

Figure 3. Discharge for the Rolling Fork River at Boston, KY, 1994-1999.

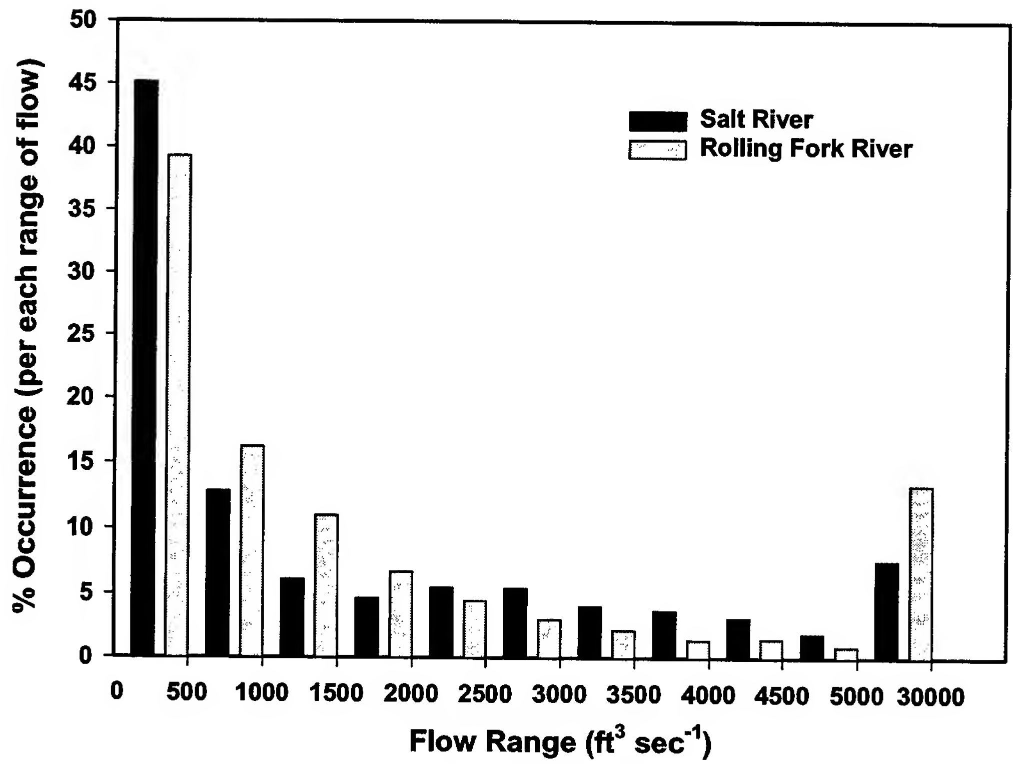

Figure 4. Frequency distribution of flow ranges for the Salt River and Rolling Fork River.

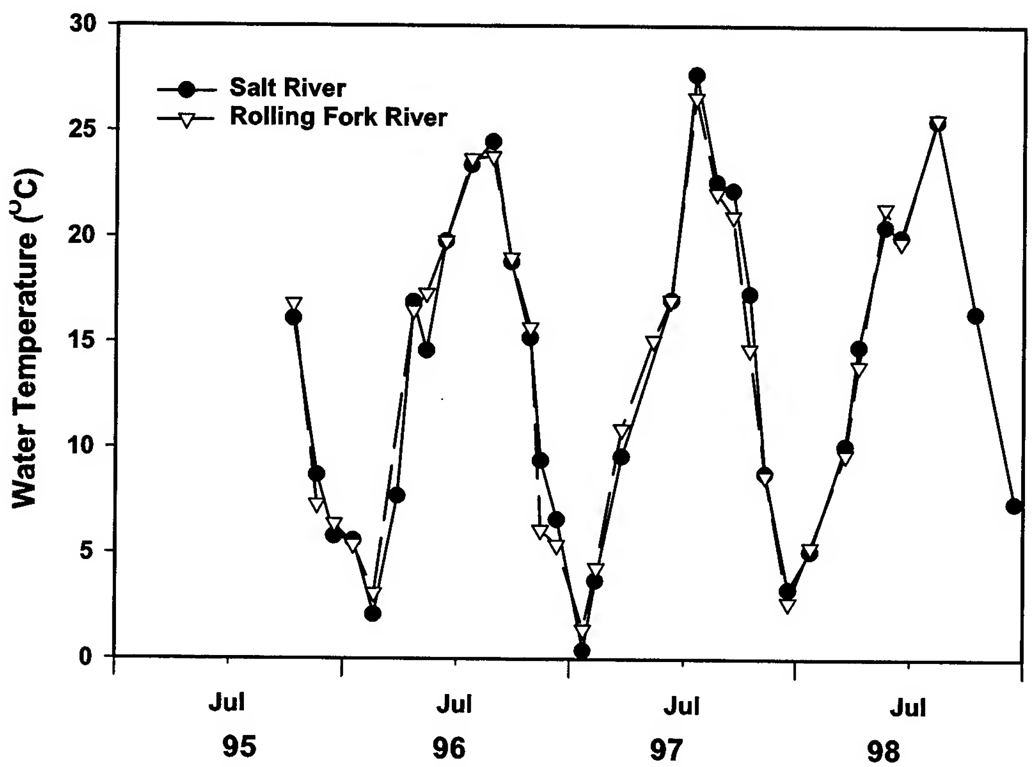

Figure 5. Temperature values for the Salt River and Rolling Fork River, 1995-1998.

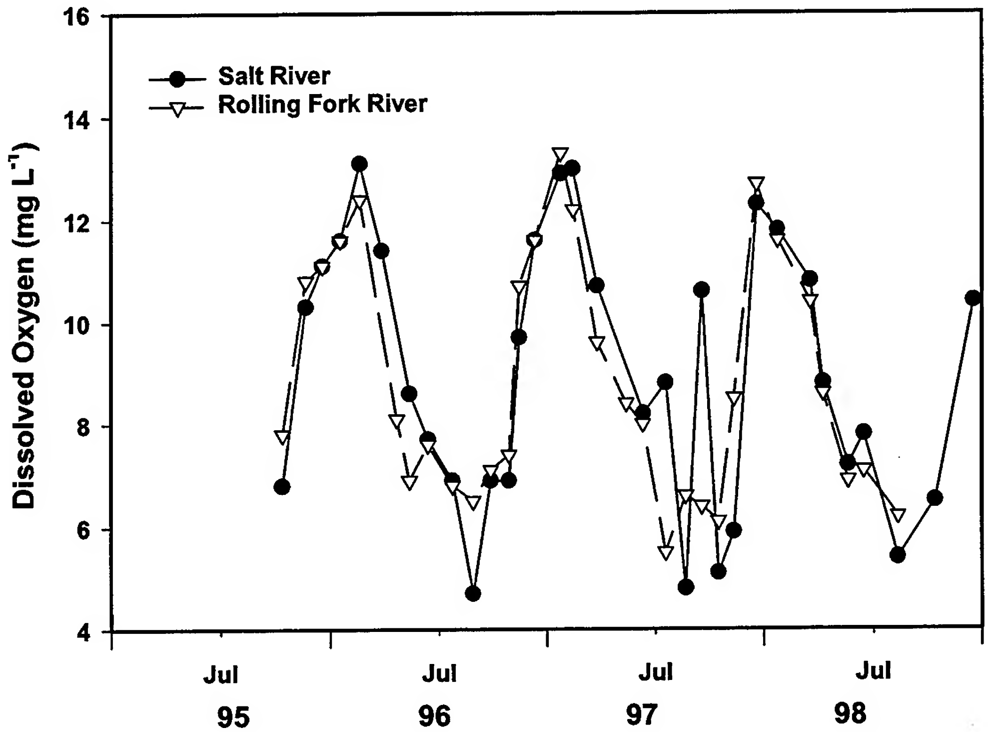

Figure 6. Dissolved oxygen concentrations for the Salt River and Rolling Fork River, 1995-1998.

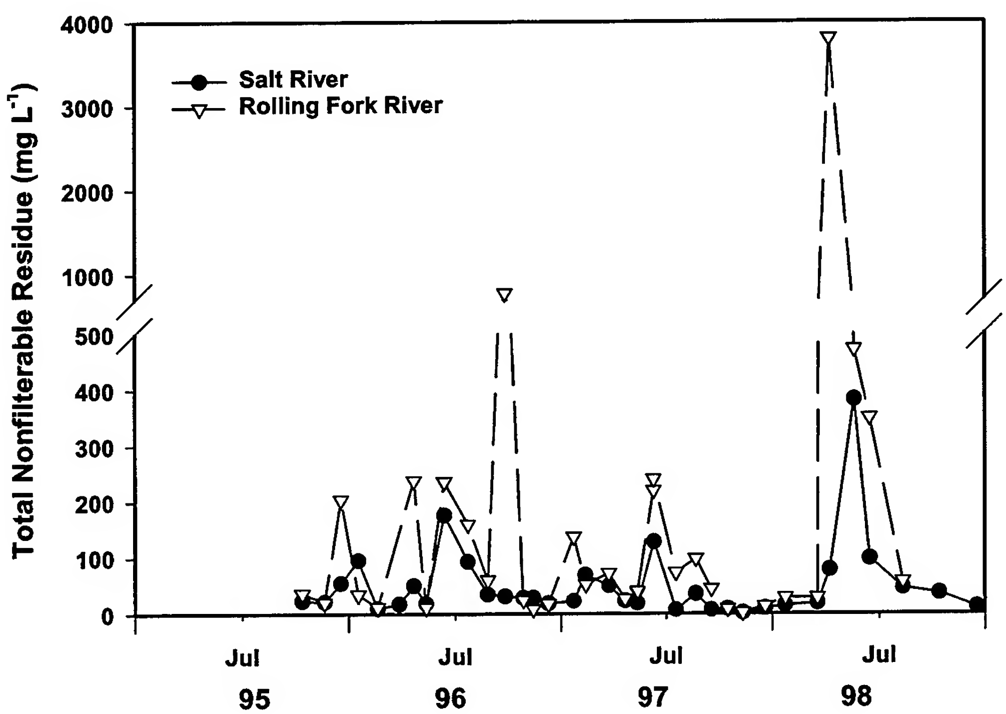

Figure 7. Total nonfilterable residue concentrations for the Salt River and Rolling Fork River, 1995-1998.

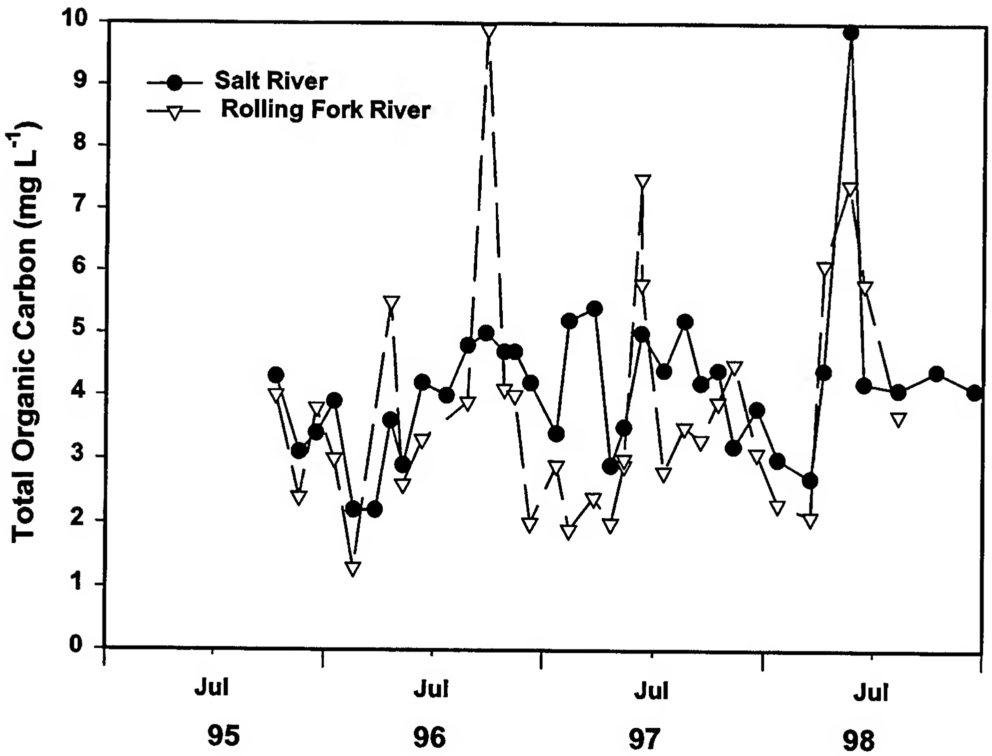

Figure 8. Total organic carbon concentrations for the Salt River and Rolling Fork River, 1995-1998.

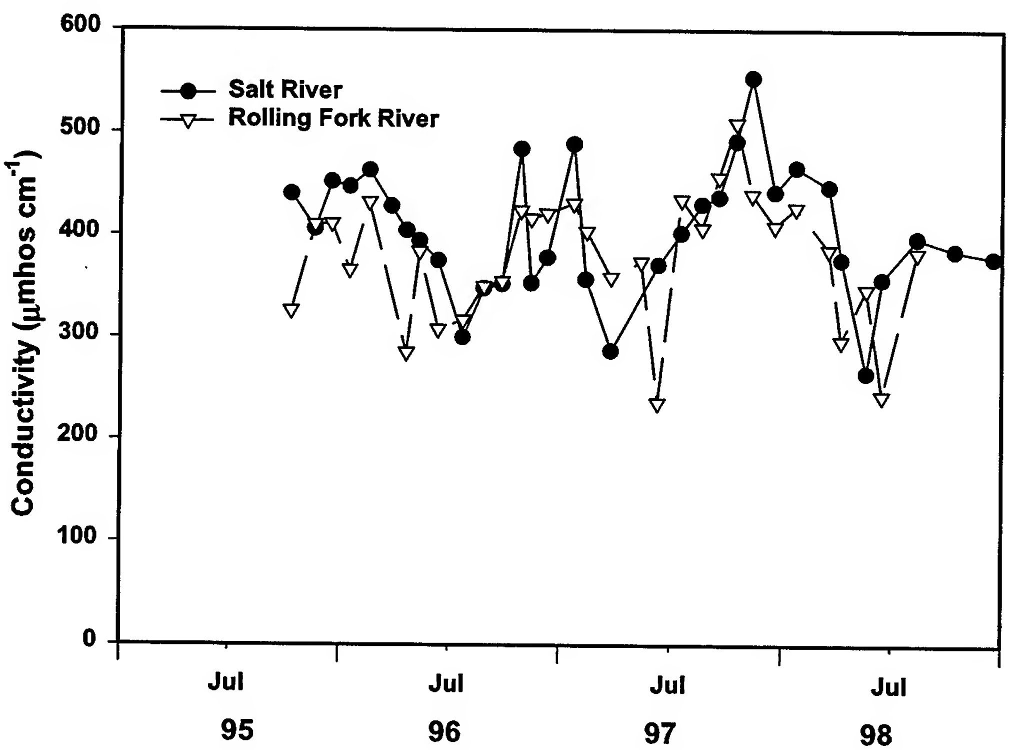

Figure 9. Conductivity values for the Salt River and Rolling Fork River, 1995-1998.

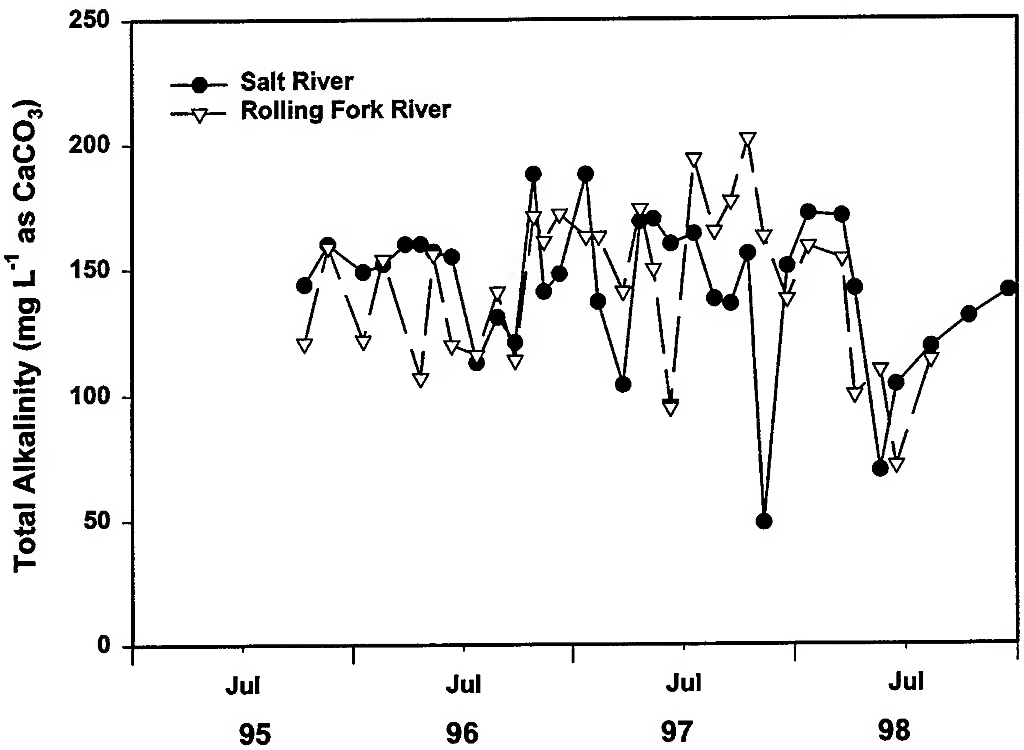

Figure 10. Total alkalinity values for the Salt River and Rolling Fork River, 1995-1998.

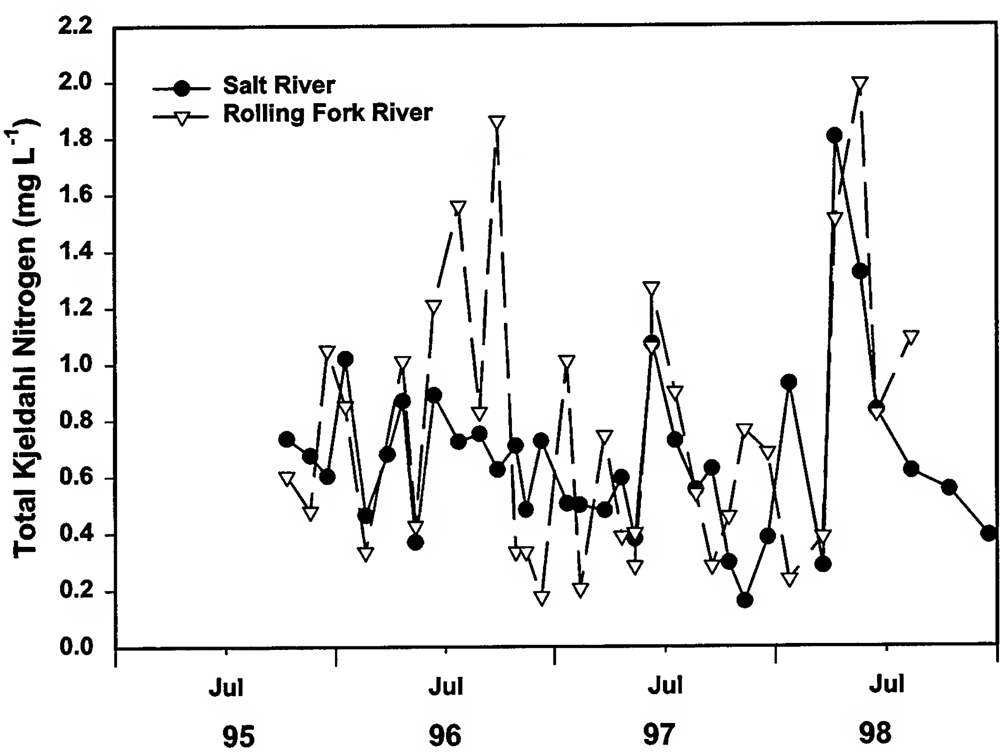

Figure 11. Total Kjeldahl nitrogen concentrations for the Salt River and Rolling Fork River, 1995-1998.

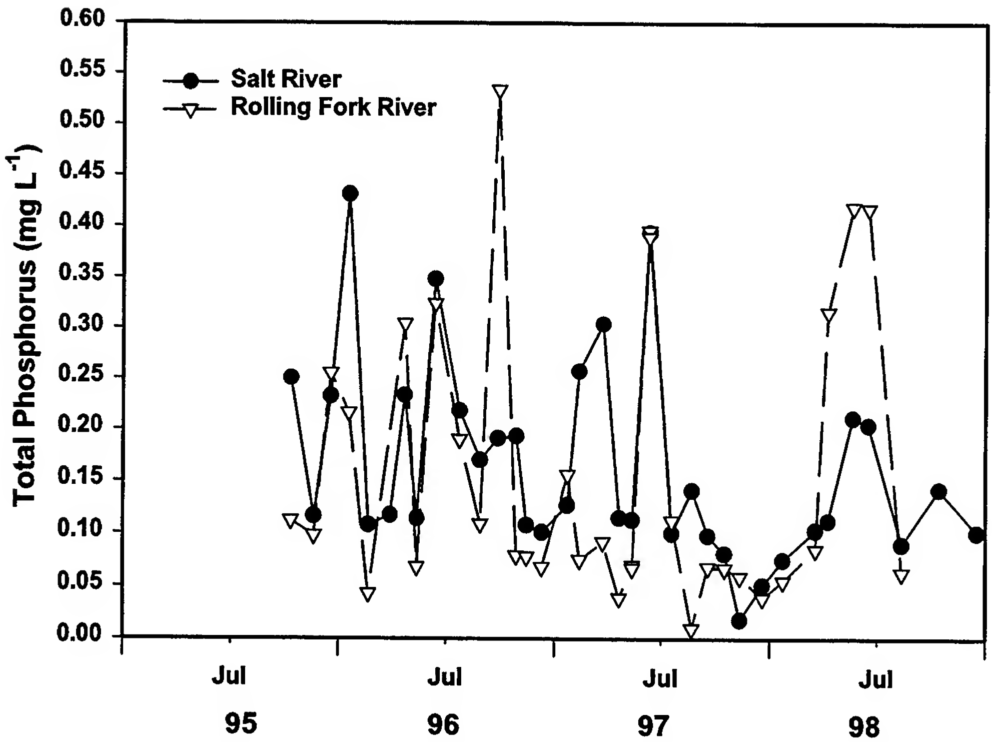

Figure 12. Total phosphorus concentrations for the Salt River and Rolling Fork River, 1995-1998.

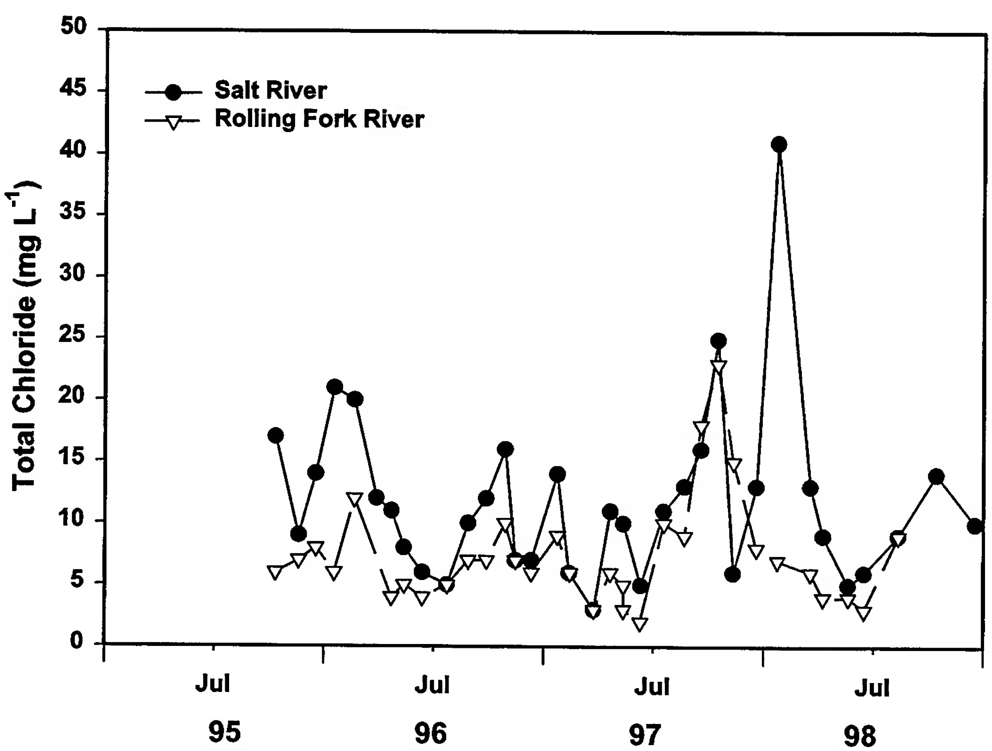

Figure 13. Total chloride concentrations for the Salt River and Rolling Fork River, 1995-1998.

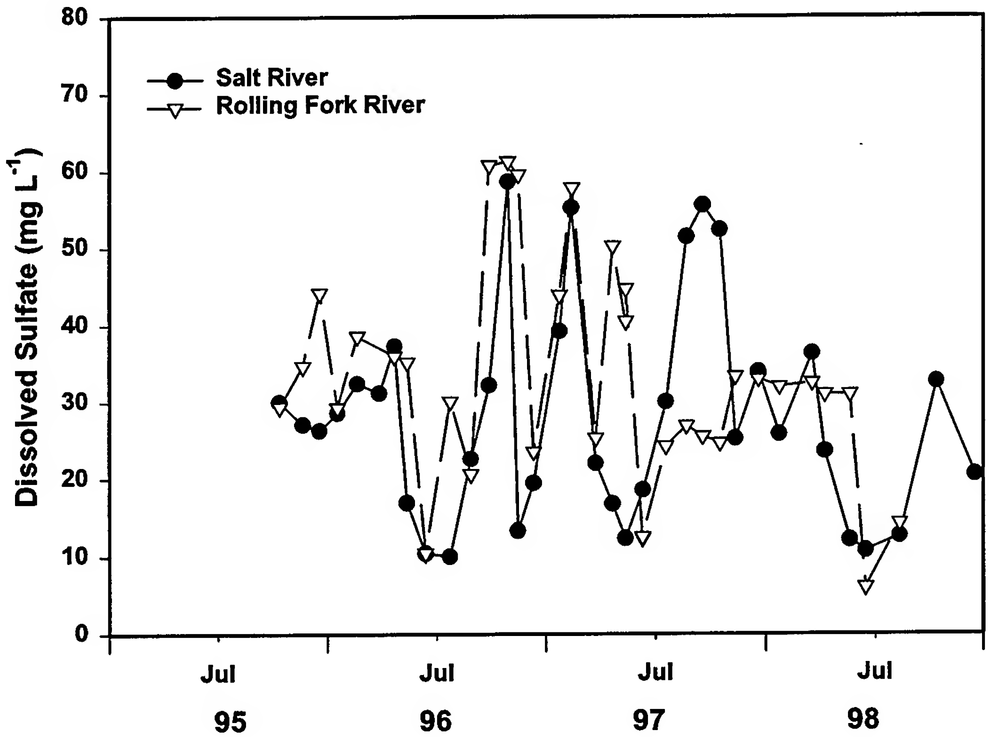

Figure 14. Dissolved sulfate concentrations for the Salt River and Rolling Fork River, 1995-1998.

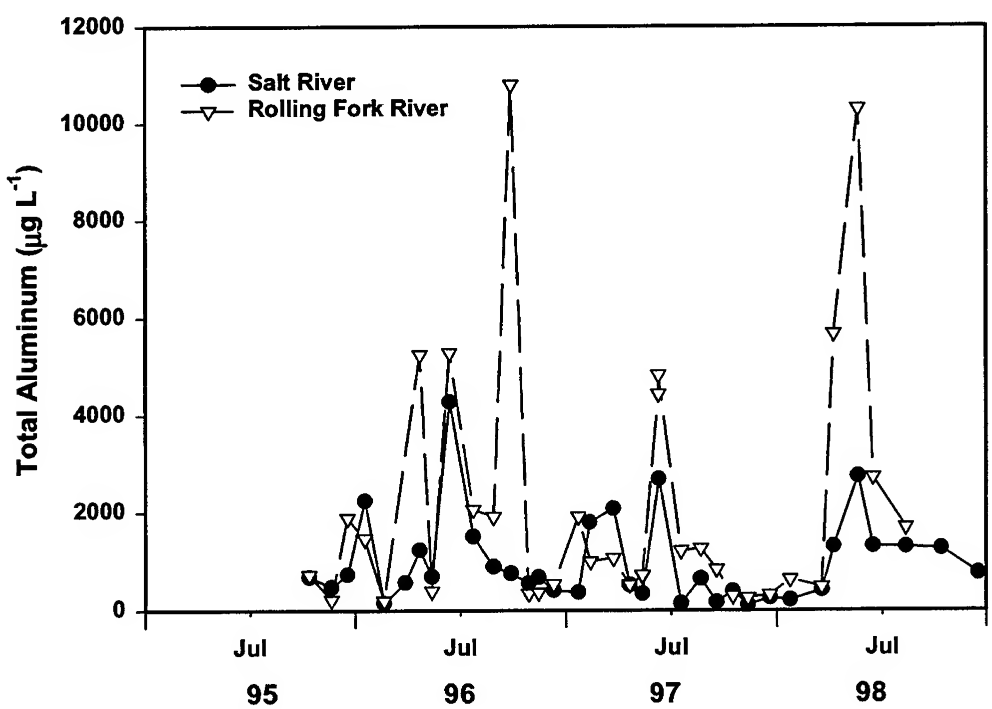

Figure 15. Total aluminum concentrations for the Salt River and Rolling Fork River, 1995-1998.

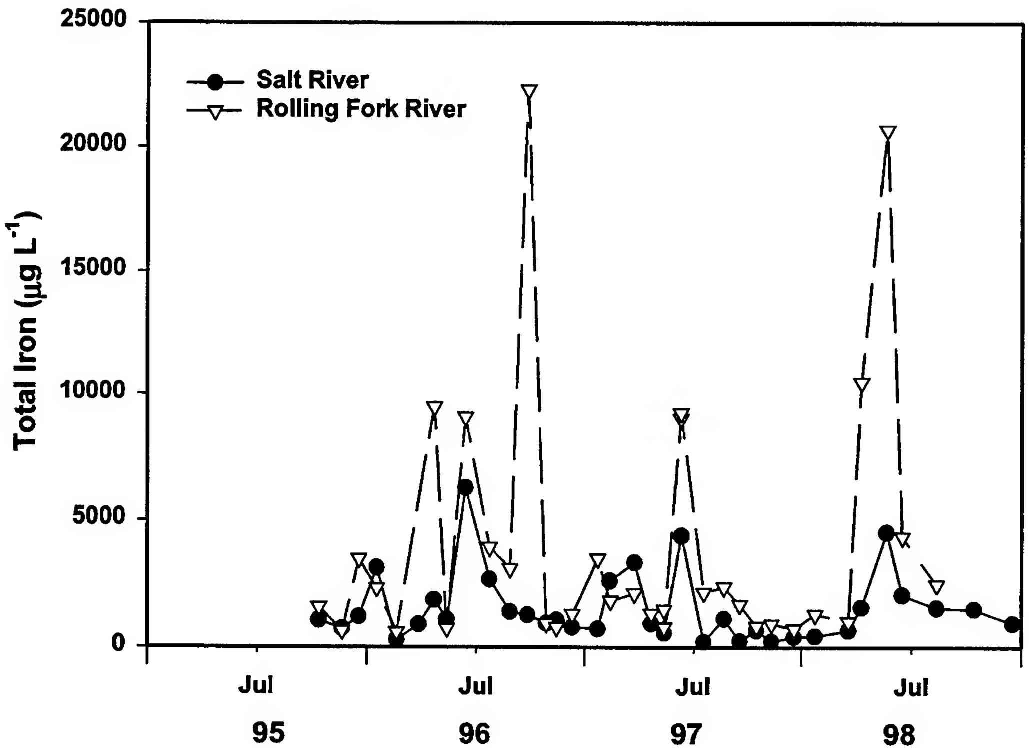

Figure 16. Total iron concentrations for the Salt River and Rolling Fork River, 1995-1998.

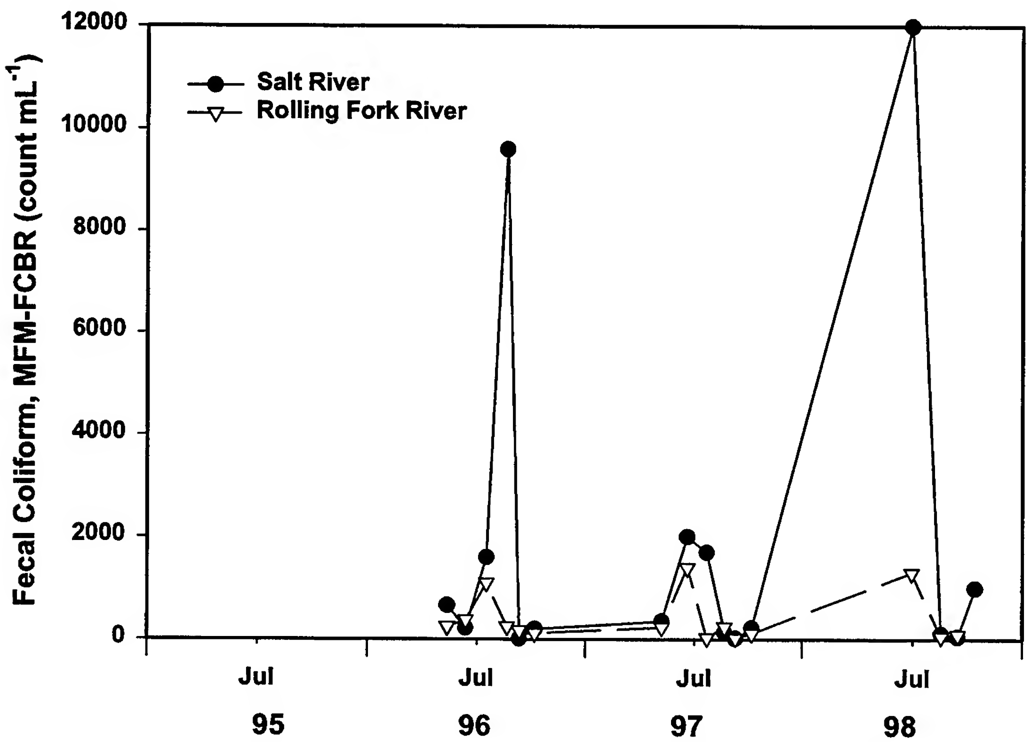

Figure 17. Fecal coliform counts for the Salt River and Rolling Fork River, 1995-1998.

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Appendix A
Minimum and Maximum Values for Selected Water Quality Constituents in the STORET Database

PARAMETER	DESCRIPTION	MAXIMUM	MINIMUM
10	Water Temp Cent	29.5	11.5
11	Water Temp Faren	85.8	52.7
76	TURB (FTU)	15	2.1
77	TRANSP Secchi (in)	42	24
94	CNDUCTVY Field (umho)	450	430
95	CNDUCTVY @25 C (umhos)	1860	245
299	DO mg/l	7	6
301	DO % sat	92.1	76.9
310	BOD5 mg/l	7	1.4
335	COD mg/l	37	2.9
340	COD mg/l	28	28
400	PH su	7.9	6.6
403	PH su	7.8	6.8
410	T Alk mg/l CaCO3	252	152
530	RESIDUE (TNFR) mg/l	38	4
556	OIL-GRSE mg/l	1	1
602	DISS. Nitrogen mg/l	1.5	3
607	ORG nitrogen mg/l	0.17	0.17
608	NH3+NH4- Nit, Diss mg/l	0.03	0.03
610	NH3+NH4- Nit, Total mg/l	7.3	0.07
612	UN-IONZD NH3-N mg/l	1.00E-04	0.00003
613	NO2-N, Diss. mg/l	0.07	0.07
618	NO3-N, Diss. mg/l	1.2	1.2
619	UN-IONZD NH3-N mg/l	2.00E-04	0.00003
620	NO3-N. Total mg/l	1.25	1.25
623	KJELDL Nit., Diss. mg/l	0.2	0.1
625	TOT Kjeldahl Nit mg/l	7.64	0.5
630	NO2&NO3 Nit, Total mg/l	4.4	0.35
631	NO2&NO3, Nit, Diss. mg/l	14	0.02
665	PHOS-TOT, mgP/l	8.4	0.05
666	PHOS-DIS mgP/l	0.05	0.01
671	PHOS-DIS. Ortho, mgP/l	7.8	0.006
680	Total Organic Carbon mg/l	7.6	0.2
720	CYANIDE, Total mg/l	0.005	0.003
722	CYANIDE, Free mg/l	0.04	0.04
746	SULFIDE, Diss. mg/l	0.1	0.1
900	Total Hardness CaCO3 mg/l	340	140
902	NC Hardness mg/l	89	1
915	CALCIUM, Diss mg/l	110	48
916	CALCIUM. Total mg/l	91	44
925	MGNSIUM, Diss mg/l	19	3.4
927	MGNSIUM, Total mg/l	19.1	10.5
929	SODIUM, Total mg/l	65	8.75
930	SODIUM, Diss mg/l	16	2.7
935	PTSSIUM, Diss mg/l	1.7	1
937	PTSSIUM, Total mg/l	10.1	2
940	CHLORIDE, Total mg/l	290	3
945	SULFATE, Total mg/l	1000	1

PARAMETER	DESCRIPTION	MAXIMUM	MINIMUM
950	FLUORIDE, Diss mg/l	0.9	0.1
955	SILICA, Diss mg/l	13	9
1002	ARSENIC, Total mg/l	50	2
1005	BARIUM, diss ug/l	42	41
1007	BARIUM, total ug/l	95	46
1010	BERYLIUM, diss ug/l	1	1
1012	BERYLIUM, total ug/l	10	10
1025	CADMIUM, diss ug/l	3	1
1027	CADMIUM, total ug/l	10	3
1030	CHROMIUM, diss ug/l	10	1
1034	CHROMIUM, total ug/l	2	1
1035	COBALT, diss ug/l	3	3
1037	COBALT, total ug/l	20	20
1040	COPPER, ug/l	10	3
1042	COPPER, total ug/l	16	10
1044	IRON, susp ug/l	1100	70
1045	IRON, total ug/l	1156	80
1046	IRON, diss ug/l	62	4
1049	LEAD, diss ug/l	15	10
1051	LEAD, total ug/l	25	18
1054	MANGNESE, susp ug/l	70	0
1055	MANGNESE, total ug/l	220	10
1056	MANGNESE, diss ug/l	182	0
1059	THALLIUM, total ug/l	100	100
1060	MOLY, diss ug/l	10	10
1062	MOLY, total ug/l	20	20
1064	TELLURUM, total ug/l	40	40
1067	NICKEL, total ug/l	23	8
1077	SILVER, total ug/l	10	1
1080	STRONTUM, diss ug/l	81	58
1082	STRONTUM, total ug/l	310	160
1085	VANADIUM, diss ug/l	6	6
1087	VANADIUM, total ug/l	10	10
1090	ZINC, diss ug/l	170	78
1092	ZINC, total ug/l	100	17
1097	ANTIMONY, total ug/l	40	40
1102	TIN, total ug/l	100	100
1105	ALUMINUM, total ug/l	2400	292
1106	ALUMINUM, diss ug/l	353	131
1108	AL, MUD Dry Wt mg/kg-Al	28300	1.05E+04
1147	SELENIUM, total ug/l	50	1
1153	TITANIUM, total ug/l	102	102

Appendix B
Data from the Kentucky Division of Water Monitoring Program

LOCATION	DATE	Jday	TIME	DEPTH	10		94		300		400		410	
					WATER		CNDUCTVY		DO		PH		T ALK	
					TEMP		FIELD						CACO3	
					CENT		MICROMHO		MG/L		SU		MG/L	
SALT RIVER AT SHEPHERDSVILLE	951012	285	1120	0.983999	16.1	@	440	@	6.8	@	7.6	@	144	@
SALT RIVER AT SHEPHERDSVILLE	951120	324	1135	0.983999	8.7	@	406	@	10.3	@	7.8	@	160	@
SALT RIVER AT SHEPHERDSVILLE	951218	352	1115	0.983999	5.8	@	452	@	11.1	@	7.9	@		@
SALT RIVER AT SHEPHERDSVILLE	960117	382	1055	0.983999	5.6	@	447	@	11.6	@	8	@	149	@
SALT RIVER AT SHEPHERDSVILLE	960219	415	1240	0.983999	2.1	@	463	@	13.1	@	7.8	@	152	@
SALT RIVER AT SHEPHERDSVILLE	960328	452	1125	0.983999	7.7	@	428	@	11.4	@	7.9	@	160	@
SALT RIVER AT SHEPHERDSVILLE	960422	477	1110	0.983999	16.9	@	404	@		@	7.8	@	160	@
SALT RIVER AT SHEPHERDSVILLE	960513	498	1200	0.983999	14.6	@	394	@	8.6	@	7.4	@	157	@
SALT RIVER AT SHEPHERDSVILLE	960613	529	1130	0.983999	19.8	@	375	@	7.7	@	7.6	@	155	@
SALT RIVER AT SHEPHERDSVILLE	960718	564	1205	0.983999		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE	960724	570	1110	0.983999	23.4	@	300	@	6.9	@	7.5	@	113	@
SALT RIVER AT SHEPHERDSVILLE	960822	599	1110	0.983999		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE	960828	605	1120	0.983999	24.5	@	348	@	4.7	@	7.5	@	131	@
SALT RIVER AT SHEPHERDSVILLE	960912	620	1120	0.983999		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE	960927	635	1200	0.983999	18.8	@	352	@	6.9	@	7.7	@	121	@
SALT RIVER AT SHEPHERDSVILLE	961008	646	1220	0.983999		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE	961028	666	1055	0.983999	15.2	@	484	@	6.9	@	7.5	@	188	@
SALT RIVER AT SHEPHERDSVILLE	961114	683	1510	0.983999	9.4	@	353	@	9.7	@	7.3	@	141	@
SALT RIVER AT SHEPHERDSVILLE	961210	709	1100	0.983999	6.6	@	378	@	11.6	@	7.6	@	148	@
SALT RIVER AT SHEPHERDSVILLE	970122	752	1100	0.983999	0.4	@	489	@	12.9	@	7.6	@	188	@
SALT RIVER AT SHEPHERDSVILLE	970212	772	930	0.983999	3.7	@	357	@	13	@	7.5	@	137	@
SALT RIVER AT SHEPHERDSVILLE	970324	813	1240	0.983999	9.6	@	287	@	10.7	@		@	104	@
SALT RIVER AT SHEPHERDSVILLE	970421	841	1145	0.983999		@		@		@		@	169	@
SALT RIVER AT SHEPHERDSVILLE	970508	858	1115	0.983999		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE	970513	863	1030	0.983999		@		@		@		@	170	@
SALT RIVER AT SHEPHERDSVILLE	970610	892	1400	0.983999	17	@	371	@	8.2	@	7.6	@	160	@
SALT RIVER AT SHEPHERDSVILLE	970620	901	1215	0.983999		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE	970719	930	1140	0.983999	27.7	@	402	@	8.8	@	8	@	164	@
SALT RIVER AT SHEPHERDSVILLE	970723	934	1115	0.983999		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE	970822	964	915	0.983999	22.6	@	430	@	4.8	@	7.5	@	138	@
SALT RIVER AT SHEPHERDSVILLE	970822	964	1600	0.983999		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE	970909	982	1045	0.983999		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE	970918	991	1135	0.983999	22.2	@	437	@	10.6	@	8.1	@	136	@
SALT RIVER AT SHEPHERDSVILLE	971007	1010	1115	0.983999		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE	971016	1019	1030	0.983999	17.3	@	492	@	5.1	@	7.3	@	156	@

LOCATION	DATE	Jday	TIME	DEPTH	10		94		300		400		410	
					WATER		CNDUCTVY		DO		PH		T ALK	
					TEMP		FIELD						CACO3	
					CENT		MICROMHO		MG/L		SU		MG/L	
SALT RIVER AT SHEPHERDSVILLE	971111	1045	1210	0.983999	8.8	@	554	@	5.9	@	7	@	49	@
SALT RIVER AT SHEPHERDSVILLE	971219	1083	925	0.983999	3.3	@	442	@	12.3	@		@	151	@
SALT RIVER AT SHEPHERDSVILLE	980123	1118	1145	0.983999	5.1	@	466	@	11.8	@	7.9	@	172	@
SALT RIVER AT SHEPHERDSVILLE	980319	1173	900	0.983999	10.1	@	447	@	10.8	@	8	@	171	@
SALT RIVER AT SHEPHERDSVILLE	980409	1194	925	0.983999	14.8	@	376	@	8.8	@	7.8	@	142	@
SALT RIVER AT SHEPHERDSVILLE	980521	1236	825	0.983999	20.5	@	265	@	7.2	@	7.4	@	70	@
SALT RIVER AT SHEPHERDSVILLE	980616	1262	840	0.983999	20	@	357	@	7.8	@	7.5	@	104	@
SALT RIVER AT SHEPHERDSVILLE	980630	1276	1330	0.983999		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE	980812	1319	900	0.983999	25.5	@	397	@	5.4	@	7.6	@	119	@
SALT RIVER AT SHEPHERDSVILLE	980818	1325	1215	0.983999		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE	980915	1353	1300	0.983999		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE	981014	1382	920	0.983999	16.4	@	385	@	6.5	@	7.7	@	131	@
SALT RIVER AT SHEPHERDSVILLE	981014	1382	1205	0.983999		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE	981217	1446	1110	0.983999	7.4	@	378	@	10.4	@	7.7	@	141	@
ROLLING FORK NEAR LEBANON JUNCTION	951012	285		0.983999	16.8	@	326	@	7.8	@	7.6	@	121	@
ROLLING FORK NEAR LEBANON JUNCTION	951120	324	1210	0.983999	7.3	@	410	@	10.8	@	7.8	@	159	@
ROLLING FORK NEAR LEBANON JUNCTION	951218	352	1200	0.983999	6.4	@	411	@	11.1	@	7.9	@		@
ROLLING FORK NEAR LEBANON JUNCTION	960117	382	1155	0.983999	5.4	@	366	@	11.6	@	8	@	122	@
ROLLING FORK NEAR LEBANON JUNCTION	960219	415	1330	0.983999	3.1	@	432	@	12.4	@	7.7	@	154	@
ROLLING FORK NEAR LEBANON JUNCTION	960422	477	1230	0.983999	16.5	@	285	@	8.1	@	7.6	@	107	@
ROLLING FORK NEAR LEBANON JUNCTION	960513	498	1310	0.983999	17.3	@	384	@	6.9	@	7.3	@	156	@
ROLLING FORK NEAR LEBANON JUNCTION	960613	529	1230	0.983999	19.8	@	308	@	7.6	@	7.6	@	120	@
ROLLING FORK NEAR LEBANON JUNCTION	960718	564	1120	0.983999		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	960724	570	1220	0.983999	23.7	@	317	@	6.8	@	7.4	@	116	@
ROLLING FORK NEAR LEBANON JUNCTION	960822	599	1045	0.983999		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	960828	605	1220	0.983999	23.8	@	350	@	6.5	@	7.7	@	141	@
ROLLING FORK NEAR LEBANON JUNCTION	960912	620	1050	0.983999		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	960927	635	1305	0.983999	19	@	355	@	7.1	@	7.7	@	114	@
ROLLING FORK NEAR LEBANON JUNCTION	961008	646	1150	0.983999		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	961028	666	1130	0.983999	15.7	@	424	@	7.4	@	7.5	@		@
ROLLING FORK NEAR LEBANON JUNCTION	961028	666	1133	0.983999		@		@		@		@	171	@
ROLLING FORK NEAR LEBANON JUNCTION	961114	683	1610	0.983999	6.1	@	416	@	10.7	@	7.8	@	161	@
ROLLING FORK NEAR LEBANON JUNCTION	961210	709	1130	0.983999	5.4	@	421	@	11.6	@	7.6	@	172	@
ROLLING FORK NEAR LEBANON JUNCTION	970122	752	1215	0.983999	1.4	@	431	@	13.3	@	7.6	@	163	@
ROLLING FORK NEAR LEBANON JUNCTION	970212	773	1025	0.983999	4.3	@	404	@	12.2	@	7.6	@	163	@

LOCATION	DATE	Jday	TIME	DEPTH	10		94		300		400		410	
					WATER		CNDUCTVY		DO		PH		T ALK	
					TEMP		FIELD						CACO3	
					CENT		MICROMHO		MG/L		SU		MG/L	
ROLLING FORK NEAR LEBANON JUNCTION	970324	813	1145	0.983999	10.9	@	359	@	9.6	@		@	141	@
ROLLING FORK NEAR LEBANON JUNCTION	970421	841	1255	0.983999		@		@		@		@	174	@
ROLLING FORK NEAR LEBANON JUNCTION	970508	858	1100	0.983999		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	970513	863	1150	0.983999	15.1	@	374	@	8.4	@	7.8	@	150	@
ROLLING FORK NEAR LEBANON JUNCTION	970513	863	1155	0.983999		@		@		@		@	150	@
ROLLING FORK NEAR LEBANON JUNCTION	970610	891	1205	0.983999	17	@	236	@	8	@	7.5	@	96	@
ROLLING FORK NEAR LEBANON JUNCTION	970610	891	1210	0.983999		@		@		@		@	95	@
ROLLING FORK NEAR LEBANON JUNCTION	970620	901	1305	0.983999		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	970719	930	1310	0.983999	26.6	@	435	@	5.5	@	7.6	@	194	@
ROLLING FORK NEAR LEBANON JUNCTION	970723	934	1045	0.983999		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	970822	964	1010	0.983999	22.1	@	407	@	6.6	@	7.7	@	165	@
ROLLING FORK NEAR LEBANON JUNCTION	970822	964	1515	0.983999		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	970909	982	1005	0.983999		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	970918	991	1215	0.983999	21	@	457	@	6.4	@	7.4	@	177	@
ROLLING FORK NEAR LEBANON JUNCTION	971007	1010	1100	0.983999		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	971016	1019	1240	0.983999	14.7	@	510	@	6.1	@	7.3	@	202	@
ROLLING FORK NEAR LEBANON JUNCTION	971111	1045	1300	0.983999	8.7	@	440	@	8.5	@	7.1	@	163	@
ROLLING FORK NEAR LEBANON JUNCTION	971219	1083	1100	0.983999		@		@		@		@	138	@
ROLLING FORK NEAR LEBANON JUNCTION	971219	1083	1200	0.983999	2.7	@	409	@	12.7	@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	971219	1083		0.983999		@		@		@		@	138	@
ROLLING FORK NEAR LEBANON JUNCTION	980123	1118	1245	0.983999	5.3	@	427	@	11.6	@	7.8	@	159	@
ROLLING FORK NEAR LEBANON JUNCTION	980319	1173	1000	0.983999	9.7	@	386	@	10.4	@	7.7	@	154	@
ROLLING FORK NEAR LEBANON JUNCTION	980409	1194	1020	0.983999	13.9	@	297	@	8.6	@	7.5	@	100	@
ROLLING FORK NEAR LEBANON JUNCTION	980521	1236	915	0.983999	21.4	@	347	@	6.9	@	7.5	@	110	@
ROLLING FORK NEAR LEBANON JUNCTION	980616	1262	930	0.983999	19.8	@	243	@	7.1	@	7.4	@	72	@
ROLLING FORK NEAR LEBANON JUNCTION	980630	1276	1300	0.983999		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	980812	1319	1030	0.983999	25.6	@	383	@	6.2	@	7.6	@	114	@
ROLLING FORK NEAR LEBANON JUNCTION	980818	1325	1145	0.983999		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	980915	1353	1230	0.983999		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	981014	1382	1020	0.983999	15.2	@	373	@	7.8	@	7.7	@	142	@
ROLLING FORK NEAR LEBANON JUNCTION	981014	1382	1140	0.983999		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	981217	1446	1200	0.983999	5.6	@	381	@	11.1	@	7.8	@	134	@

LOCATION	940		946		530		680		1105		1002		1027	
	CHLORIDE		SULFATE		RESIDUE		T ORG C		ALUMINUM		ARSENIC		CADMIUM	
	TOTAL		S04-DISS		TOT NFLT		C		AL,TOT		AS,TOT		CD,TOT	
	MG/L		MG/L		MG/L		MG/L		UG/L		UG/L		UG/L	
SALT RIVER AT SHEPHERDSVILLE	17	@	30	@	23	@	4.3	@	676	@	2	K	1	K
SALT RIVER AT SHEPHERDSVILLE	9	@	27.1	@	21	@	3.1	@	470	@	2	K	1	K
SALT RIVER AT SHEPHERDSVILLE	14	@	26.3	@	54	@	3.4	@	728	@	2	K	1	K
SALT RIVER AT SHEPHERDSVILLE	21	@	28.6	@	95	@	3.9	@	2240	@	2	@	1	K
SALT RIVER AT SHEPHERDSVILLE	20	@	32.4	@	9	@	2.2	@	147	@	2	K	1	K
SALT RIVER AT SHEPHERDSVILLE	12	@	31.2	@	17	@	2.2	@	565	@	2	K	1	K
SALT RIVER AT SHEPHERDSVILLE	11	@	37.3	@	50	@	3.6	@	1230	@	2	K	1	K
SALT RIVER AT SHEPHERDSVILLE	8	@	16.9	@	18	@	2.9	@	688	@	2	K	1	K
SALT RIVER AT SHEPHERDSVILLE	6	@	10.4	@	176	@	4.2	@	4280	@	2	K	1	K
SALT RIVER AT SHEPHERDSVILLE		@		@		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE	5	@	10	@	93	@	4	@	1510	@	2	K	1	K
SALT RIVER AT SHEPHERDSVILLE		@		@		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE	10	@	22.6	@	34	@	4.8	@	891	@	2	K	1	K
SALT RIVER AT SHEPHERDSVILLE		@		@		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE	12	@	32.2	@	31	@	5	@	751	@	2	K	1	K
SALT RIVER AT SHEPHERDSVILLE		@		@		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE	16	@	58.6	@	28	@	4.7	@	551	@	2	K	1	K
SALT RIVER AT SHEPHERDSVILLE	7	@	13.3	@	28	@	4.7	@	673	@	2	K	1	K
SALT RIVER AT SHEPHERDSVILLE	7	@	19.4	@	18	@	4.2	@	404	@	2	K	1	K
SALT RIVER AT SHEPHERDSVILLE	14	@	39.2	@	22	@	3.4	@	362	@	2	K	1	K
SALT RIVER AT SHEPHERDSVILLE	6	@	55.2	@	69	@	5.2	@	1800	@	2	K	1	K
SALT RIVER AT SHEPHERDSVILLE	3	@	22	@	50	@	5.4	@	2080	@	2	K	1	K
SALT RIVER AT SHEPHERDSVILLE	11	@	16.7	@	23	@	2.9	@	517	@	2	K	1	K
SALT RIVER AT SHEPHERDSVILLE		@		@		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE	10	@	12.3	@	18	@	3.5	@	336	@	2	K	1	K
SALT RIVER AT SHEPHERDSVILLE	5	@	18.5	@	128	@	5	@	2690	@	2	K	1	K
SALT RIVER AT SHEPHERDSVILLE		@		@		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE	11	@	30	@	6	@	4.4	@	135	@	3	@	1	K
SALT RIVER AT SHEPHERDSVILLE		@		@		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE	13	@	51.4	@	35	@	5.2	@	641	@	2	K	1	K
SALT RIVER AT SHEPHERDSVILLE		@		@		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE		@		@		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE	16	@	55.5	@	6	@	4.2	@	161	@	2	K	1	K
SALT RIVER AT SHEPHERDSVILLE		@		@		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE	25	@	52.3	@	8	@	4.4	@	388	@	2	K	1	K

LOCATION	940		946		530		680		1105		1002		1027	
	CHLORIDE		SULFATE		RESIDUE		T ORG C		ALUMINUM		ARSENIC		CADMIUM	
	TOTAL		S04-DISS		TOT NFLT		C		AL,TOT		AS,TOT		CD,TOT	
	MG/L		MG/L		MG/L		MG/L		UG/L		UG/L		UG/L	
SALT RIVER AT SHEPHERDSVILLE	6	@	25.2	@	1	K	3.2	@	102	@	2	K	1	K
SALT RIVER AT SHEPHERDSVILLE	13	@	33.9	@	9	@	3.8	@	251	@	2	K	1	K
SALT RIVER AT SHEPHERDSVILLE	41	@	25.8	@	14	@	3	@	207	@	2	K	1	K
SALT RIVER AT SHEPHERDSVILLE	13	@	36.3	@	18	@	2.7	@	408	@	2	K	1	K
SALT RIVER AT SHEPHERDSVILLE	9	@	23.5	@	78	@	4.4	@	1300	@	2	K	1	K
SALT RIVER AT SHEPHERDSVILLE	5	@	12.1	@	382	@	9.9	@	2740	@	2	K	1	K
SALT RIVER AT SHEPHERDSVILLE	6	@	10.7	@	98	@	4.2	@	1300	@	2	K	1	K
SALT RIVER AT SHEPHERDSVILLE		@		@		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE	9	@	12.6	@	46	@	4.1	@	1290	@	2	K	1	K
SALT RIVER AT SHEPHERDSVILLE		@		@		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE		@		@		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE	14	@	32.6	@	36	@	4.4	@	1260	@	2	K	1	K
SALT RIVER AT SHEPHERDSVILLE		@		@		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE	10	@	20.5	@	11	@	4.1	@	752	@	2	K	1	K
ROLLING FORK NEAR LEBANON JUNCTION	6	@	29.4	@	36	@	4	@	721	@	2	K	1	K
ROLLING FORK NEAR LEBANON JUNCTION	7	@	34.7	@	20	@	2.4	@	214	@	2	K	1	K
ROLLING FORK NEAR LEBANON JUNCTION	8	@	44.2	@	204	@	3.8	@	1880	@	2	K	1	K
ROLLING FORK NEAR LEBANON JUNCTION	6	@	29.3	@	34	@	3	@	1460	@	2	K	1	K
ROLLING FORK NEAR LEBANON JUNCTION	12	@	38.6	@	11	@	1.3	@	191	@	2	K	1	K
ROLLING FORK NEAR LEBANON JUNCTION	4	@	36	@	238	@	5.5	@	5250	@	2	K	1	K
ROLLING FORK NEAR LEBANON JUNCTION	5	@	35.2	@	11	@	2.6	@	394	@	2	K	1	K
ROLLING FORK NEAR LEBANON JUNCTION	4	@	10.4	@	236	@	3.3	@	5290	@	2	K	1	K
ROLLING FORK NEAR LEBANON JUNCTION		@		@		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	5	@	30.1	@	160	@		@	2060	@	3	@	1	K
ROLLING FORK NEAR LEBANON JUNCTION		@		@		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	7	@	20.6	@	60	@	3.9	@	1910	@	2	@	1	K
ROLLING FORK NEAR LEBANON JUNCTION		@		@		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	7	@	60.7	@	776	@	9.9	@	10800	@	6	@	1	K
ROLLING FORK NEAR LEBANON JUNCTION		@		@		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION		@		@		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	10	@	61.2	@	24	@	4.1	@	337	@	2	K	1	K
ROLLING FORK NEAR LEBANON JUNCTION	7	@	59.5	@	8	@	4	@	360	@	2	K	1	K
ROLLING FORK NEAR LEBANON JUNCTION	6	@	23.5	@	17	@	2	@	525	@	2	K	1	K
ROLLING FORK NEAR LEBANON JUNCTION	9	@	43.9	@	137	@	2.9	@	1910	@	2	K	1	K
ROLLING FORK NEAR LEBANON JUNCTION	6	@	57.8	@	52	@	1.9	@	997	@	2	K	1	K

LOCATION	940		946		530		680		1105		1002		1027	
	CHLORIDE		SULFATE		RESIDUE		T ORG C		ALUMINUM		ARSENIC		CADMIUM	
	TOTAL		S04-DISS		TOT NFLT		C		AL,TOT		AS,TOT		CD,TOT	
	MG/L		MG/L		MG/L		MG/L		UG/L		UG/L		UG/L	
ROLLING FORK NEAR LEBANON JUNCTION	3	@	25.3	@	72	@	2.4	@	1060	@	2	K	1	K
ROLLING FORK NEAR LEBANON JUNCTION	6	@	50.2	@	26	@	2	@	521	@	2	K	1	K
ROLLING FORK NEAR LEBANON JUNCTION		@		@		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	5	@	40.5	@	37	@	2.9	@	691	@	2	K	1	K
ROLLING FORK NEAR LEBANON JUNCTION	3	@	44.7	@	40	@	3	@	719	@	2	K	1	K
ROLLING FORK NEAR LEBANON JUNCTION	2	@	12.3	@	220	@	7.5	@	4430	@	2	K	1	K
ROLLING FORK NEAR LEBANON JUNCTION	2	@	12.5	@	240	@	5.8	@	4830	@	2	@	1	K
ROLLING FORK NEAR LEBANON JUNCTION		@		@		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	10	@	24.2	@	73	@	2.8	@	1210	@	3	@	1	K
ROLLING FORK NEAR LEBANON JUNCTION		@		@		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	9	@	26.9	@	98	@	3.5	@	1260	@	2	@	1	K
ROLLING FORK NEAR LEBANON JUNCTION		@		@		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION		@		@		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	18	@	25.5	@	44	@	3.3	@	829	@	2	@	1	K
ROLLING FORK NEAR LEBANON JUNCTION		@		@		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	23	@	24.6	@	8	@	3.9	@	284	@	2	K	1	K
ROLLING FORK NEAR LEBANON JUNCTION	15	@	33.3	@	1	K	4.5	@	253	@	2	K	1	K
ROLLING FORK NEAR LEBANON JUNCTION	8	@	33	@	13	@	3.1	@	311	@	2	K	1	K
ROLLING FORK NEAR LEBANON JUNCTION		@		@		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	8	@	33	@	13	@	3.1	@	311	@	2	K	1	K
ROLLING FORK NEAR LEBANON JUNCTION	7	@	32	@	28	@	2.3	@	627	@	2	K	1	K
ROLLING FORK NEAR LEBANON JUNCTION	6	@	32.5	@	28	@	2.1	@	476	@	2	K	1	K
ROLLING FORK NEAR LEBANON JUNCTION	4	@	31	@	3800	@	6.1	@	5670	@	2	K	1	K
ROLLING FORK NEAR LEBANON JUNCTION	4	@	31	@	472	@	7.4	@	10300	@	2	K	1	K
ROLLING FORK NEAR LEBANON JUNCTION	3	@	6	@	350	@	5.8	@	2720	@	3	@	1	K
ROLLING FORK NEAR LEBANON JUNCTION		@		@		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	9	@	14.2	@	57	@	3.7	@	1690	@	2	K	1	K
ROLLING FORK NEAR LEBANON JUNCTION		@		@		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION		@		@		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	10	@	17.3	@	31	@	4.9	@	1070	@	2	K	1	K
ROLLING FORK NEAR LEBANON JUNCTION		@		@		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	6	@	34.1	@	26	@	4.7	@	1090	@	2	K	1	K

LOCATION	1034		1042		1045		1051		1055		71900		1092	
	CHROMIUM		COPPER		IRON		LEAD		MANGNESE		MERCURY		ZINC	
	CR,TOT		CU,TOT		FE,TOT		PB,TOT		MN		HG,TOTAL		ZN,TOT	
	UG/L		UG/L		UG/L		UG/L		UG/L		UG/L		UG/L	
SALT RIVER AT SHEPHERDSVILLE	5	@	3	@	1070	@	2	K	129	@	0.1	K	4	@
SALT RIVER AT SHEPHERDSVILLE	1	K	1	K	734	@	2	K	85	@	0.1	K	2	K
SALT RIVER AT SHEPHERDSVILLE	1	@	2	@	1210	@	2	K	117	@	0.1	K	5	@
SALT RIVER AT SHEPHERDSVILLE	5	@	4	@	3130	@	5	@	330	@	0.1	K	11	@
SALT RIVER AT SHEPHERDSVILLE	1	K	1	@	285	@	2	K	33	@	0.1	K	2	@
SALT RIVER AT SHEPHERDSVILLE	1	K	1	K	902	@	2	K	62	@	0.1	K	3	@
SALT RIVER AT SHEPHERDSVILLE	2	@	1	@	1880	@	2	K	109	@	0.1	K	3	@
SALT RIVER AT SHEPHERDSVILLE	1	K	1	K	1110	@	2	K	61	@	0.1	K	4	@
SALT RIVER AT SHEPHERDSVILLE	6	@	9	@	6270	@	4	@	263	@	0.1	K	2	K
SALT RIVER AT SHEPHERDSVILLE		@		@		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE	2	@	1	@	2690	@	3	@	205	@	0.1	K	8	@
SALT RIVER AT SHEPHERDSVILLE		@		@		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE	2	@	2	@	1420	@	2	K	170	@	0.1	K	2	@
SALT RIVER AT SHEPHERDSVILLE		@		@		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE	1	@	2	@	1290	@	2	K	122	@	0.1	K	8	@
SALT RIVER AT SHEPHERDSVILLE		@		@		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE	1	@	1	@	964	@	2	K	123	@	0.1	K	5	@
SALT RIVER AT SHEPHERDSVILLE	1	@	1	@	1080	@	2	K	127	@	0.1	K	4	@
SALT RIVER AT SHEPHERDSVILLE	1	@	1	@	801	@	2	K	87	@	0.1	K	2	@
SALT RIVER AT SHEPHERDSVILLE	1	K	1	@	739	@	2	K	48	@	0.1	K	10	@
SALT RIVER AT SHEPHERDSVILLE	3	@	3	@	2630	@	3	@	166	@	0.1	K	8	@
SALT RIVER AT SHEPHERDSVILLE	2	@	6	@	3350	@	3	@	129	@	0.05	K	12	@
SALT RIVER AT SHEPHERDSVILLE	1	K	1	@	950	@	2	K	100	@	0.05	K	4	@
SALT RIVER AT SHEPHERDSVILLE		@		@		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE	1	K	1	@	565	@	2	K	98	@	0.05	K	2	@
SALT RIVER AT SHEPHERDSVILLE	3	@	2	@	4390	@	3	@	2810	@	0.05	K	12	@
SALT RIVER AT SHEPHERDSVILLE		@		@		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE	1	K	1	@	209	@	2	K	47	@	0.05	K	2	K
SALT RIVER AT SHEPHERDSVILLE		@		@		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE	2	@	2	@	1130	@	2	K	117	@	0.05	K	3	@
SALT RIVER AT SHEPHERDSVILLE		@		@		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE		@		@		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE	1	K	1	@	245	@	2	K	33	@	0.05	K	2	@
SALT RIVER AT SHEPHERDSVILLE		@		@		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE	1	K	1	@	666	@	2	K	155	@	0.05	K	3	@

LOCATION	1034		1042		1045		1051		1055		71900		1092	
	CHROMIUM		COPPER		IRON		LEAD		MANGNESE		MERCURY		ZINC	
	CR,TOT		CU,TOT		FE,TOT		PB,TOT		MN		HG,TOTAL		ZN,TOT	
	UG/L		UG/L		UG/L		UG/L		UG/L		UG/L		UG/L	
SALT RIVER AT SHEPHERDSVILLE	1	K	1	K	229	@	2	K	27	@	0.05	K	3	@
SALT RIVER AT SHEPHERDSVILLE	1	K	1	K	401	@	2	K	54	@	0.05	K	2	K
SALT RIVER AT SHEPHERDSVILLE	1	K	1	K	441	@	3	@	43	@	0.05	K	3	@
SALT RIVER AT SHEPHERDSVILLE	1	K	1	K	676	@	2	K	59	@	0.05	K	2	@
SALT RIVER AT SHEPHERDSVILLE	2	@	2	@	1590	@	2	K	108	@	0.05	K	12	@
SALT RIVER AT SHEPHERDSVILLE	5	@	5	@	4530	@	7	@	382	@	0.05	K	36	@
SALT RIVER AT SHEPHERDSVILLE	2	@	2	@	2080	@	2	@	192	@	0.05	K	9	@
SALT RIVER AT SHEPHERDSVILLE		@		@		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE	1	@	2	@	1570	@	2	K	163	@	0.05	K	8	K
SALT RIVER AT SHEPHERDSVILLE		@		@		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE		@		@		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE	2	@	2	@	1520	@	2	K	149	@	0.05	K	8	K
SALT RIVER AT SHEPHERDSVILLE		@		@		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE	1	K	1	K	960	@	2	K	101	@	0.05	K	5	K
ROLLING FORK NEAR LEBANON JUNCTION	2	@	2	@	1600	@	2	K	82	@	0.1	K	4	@
ROLLING FORK NEAR LEBANON JUNCTION	1	K	1	K	649	@	2	K	54	@	0.1	K	2	K
ROLLING FORK NEAR LEBANON JUNCTION	1	K	4	@	3480	@	5	@	198	@	0.1	K	12	@
ROLLING FORK NEAR LEBANON JUNCTION	4	@	3	@	2340	@	3	@	163	@	0.1	K	11	@
ROLLING FORK NEAR LEBANON JUNCTION	1	K	1	@	604	@	2	K	52	@	0.1	K	3	@
ROLLING FORK NEAR LEBANON JUNCTION	7	@	6	@	9480	@	5	@	267	@	0.1	K	25	@
ROLLING FORK NEAR LEBANON JUNCTION	1	K	1	@	757	@	2	K	44	@	0.1	K	5	@
ROLLING FORK NEAR LEBANON JUNCTION	6	@	6	@	9070	@	6	@	253	@	0.1	K	2	K
ROLLING FORK NEAR LEBANON JUNCTION		@		@		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	6	@	5	@	3940	@	4	@	158	@	0.1	K	13	@
ROLLING FORK NEAR LEBANON JUNCTION		@		@		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	2	@	3	@	3110	@	2	@	114	@	0.1	K	8	@
ROLLING FORK NEAR LEBANON JUNCTION		@		@		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	1	K	13	@	22300	@	17	@	585	@	0.1	K	45	@
ROLLING FORK NEAR LEBANON JUNCTION		@		@		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION		@		@		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	1	K	2	@	952	@	2	K	73	@	0.1	K	6	@
ROLLING FORK NEAR LEBANON JUNCTION	1	K	1	@	800	@	2	K	48	@	0.1	K	5	@
ROLLING FORK NEAR LEBANON JUNCTION	1	@	1	@	1320	@	2	K	63	@	0.1	K	5	@
ROLLING FORK NEAR LEBANON JUNCTION	4	@	3	@	3500	@	3	@	144	@	0.1	K	13	@
ROLLING FORK NEAR LEBANON JUNCTION	1	@	1	@	1850	@	2	K	77	@	0.1	K	8	@

LOCATION	1034		1042		1045		1051		1055		71900		1092	
	CHROMIUM		COPPER		IRON		LEAD		MANGNESE		MERCURY		ZINC	
	CR,TOT		CU,TOT		FE,TOT		PB,TOT		MN		HG,TOTAL		ZN,TOT	
	UG/L		UG/L		UG/L		UG/L		UG/L		UG/L		UG/L	
ROLLING FORK NEAR LEBANON JUNCTION	1	@	2	@	2130	@	2	K	106	@	0.05	K	12	@
ROLLING FORK NEAR LEBANON JUNCTION	1	K	1	@	1340	@	2	K	126	@	0.05	K	5	@
ROLLING FORK NEAR LEBANON JUNCTION		@		@		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	1	@	2	@	1500	@	2	K	102	@	0.05	K	5	@
ROLLING FORK NEAR LEBANON JUNCTION	1	@	2	@	800	@	2	K	87	@	0.05	K	4	@
ROLLING FORK NEAR LEBANON JUNCTION	5	@	4	@	9020	@	4	@	240	@	0.05	K	21	@
ROLLING FORK NEAR LEBANON JUNCTION	6	@	5	@	9240	@	5	@	258	@	0.05	K	22	@
ROLLING FORK NEAR LEBANON JUNCTION		@		@		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	3	@	2	@	2170	@	3	@	123	@	0.05	K	5	@
ROLLING FORK NEAR LEBANON JUNCTION		@		@		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	3	@	3	@	2380	@	3	@	180	@	0.05	K	6	@
ROLLING FORK NEAR LEBANON JUNCTION		@		@		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION		@		@		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	2	@	1	@	1700	@	3	@	194	@	0.05	K	5	@
ROLLING FORK NEAR LEBANON JUNCTION		@		@		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	1	K	1	@	841	@	2	K	305	@	0.05	K	2	@
ROLLING FORK NEAR LEBANON JUNCTION	1	K	1	@	934	@	2	K	99	@	0.05	K	2	@
ROLLING FORK NEAR LEBANON JUNCTION	1	K	1	@	726	@	2	K	48	@	0.05	K	2	K
ROLLING FORK NEAR LEBANON JUNCTION		@		@		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	1	K	1	@	726	@	2	K	48	@	0.05	K	2	K
ROLLING FORK NEAR LEBANON JUNCTION	1	@	1	@	1310	@	3	@	69	@	0.05	K	4	@
ROLLING FORK NEAR LEBANON JUNCTION	1	K	1	K	1030	@	2	K	60	@	0.05	K	4	@
ROLLING FORK NEAR LEBANON JUNCTION	8	@	8	@	10500	@	6	@	343	@	0.05	K	45	@
ROLLING FORK NEAR LEBANON JUNCTION	5	@	7	@	20700	@	9	@	599	@	0.05	K	55	@
ROLLING FORK NEAR LEBANON JUNCTION	6	@	5	@	4360	@	8	@	348	@	0.05	K	19	@
ROLLING FORK NEAR LEBANON JUNCTION		@		@		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	2	@	3	@	2500	@	2	K	126	@	0.05	K	8	K
ROLLING FORK NEAR LEBANON JUNCTION		@		@		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION		@		@		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	2	@	2	@	1630	@	2	K	121	@	0.05	K	8	K
ROLLING FORK NEAR LEBANON JUNCTION		@		@		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	1	K	1	K	1670	@	2	K	83	@	0.05	K	8	K

LOCATION	916		927		937		929		900		610		630	
	CALCIUM		MGNSIUM		PTSSIUM		SODIUM		TOT HARD		NH3+NH4-		NO2&NO3	
	CA-TOT		MG,TOT		K,TOT		NA,TOT		CACO3		N TOTAL		N-TOTAL	
	MG/L		MG/L		MG/L		MG/L		MG/L		MG/L		MG/L	
SALT RIVER AT SHEPHERDSVILLE	53.5	@	12	@	6.24	@	12.2	@	183	@	0.05	K	1.27	@
SALT RIVER AT SHEPHERDSVILLE	60.3	@	9.4	@	3.54	@	4.8	@	189	@	0.166	@	1.13	@
SALT RIVER AT SHEPHERDSVILLE	61.1	@	13.7	@	3.72	@	7.62	@	209	@	0.05	K	1.68	@
SALT RIVER AT SHEPHERDSVILLE	61.6	@	11.3	@	3.01	@	9.61	@	200	@	0.065	@	1.55	@
SALT RIVER AT SHEPHERDSVILLE	68.9	@	10.9	@	2.45	@	7.74	@	217	@	0.05	K	1.48	@
SALT RIVER AT SHEPHERDSVILLE	66.3	@	11.2	@	2.14	@	6.41	@	212	@	0.05	K	1.54	@
SALT RIVER AT SHEPHERDSVILLE	63.3	@	11.6	@	2.83	@	6.43	@	206	@	0.05	K	1.24	@
SALT RIVER AT SHEPHERDSVILLE	56.3	@	9.4	@	2.15	@	4.07	@	179	@	0.05	K	1.25	@
SALT RIVER AT SHEPHERDSVILLE	61.1	@	10.4	@	3.09	@	3.48	@	195	@	0.05	K	1.22	@
SALT RIVER AT SHEPHERDSVILLE		@		@		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE	47.5	@	5.7	@	3.34	@	3.39	@	142	@	0.05	K	0.44	@
SALT RIVER AT SHEPHERDSVILLE		@		@		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE	46.2	@	7.5	@	4.11	@	6.03	@	146	@	0.052	@	0.6	@
SALT RIVER AT SHEPHERDSVILLE		@		@		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE	45.8	@	8.7	@	3.66	@	7.76	@	150	@	0.05	K	0.74	@
SALT RIVER AT SHEPHERDSVILLE		@		@		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE	64.3	@	14.5	@	4.7	@	10.4	@	220	@	0.05	K	0.68	@
SALT RIVER AT SHEPHERDSVILLE	56.3	@	7	@	3.34	@	3.95	@	169	@	0.05	K	0.62	@
SALT RIVER AT SHEPHERDSVILLE	61.8	@	8	@	3.24	@	4.75	@	187	@	0.05	K	0.95	@
SALT RIVER AT SHEPHERDSVILLE	67.5	@	11.6	@	2.33	@	7.38	@	216	@	0.05	K	1.51	@
SALT RIVER AT SHEPHERDSVILLE	53	@	7	@	2.47	@	3.57	@	161	@	0.05	K	1.41	@
SALT RIVER AT SHEPHERDSVILLE	41.3	@	5.9	@	2.34	@	2.73	@	127	@	0.05	K	0.97	@
SALT RIVER AT SHEPHERDSVILLE	69.6	@	14.8	@	2.57	@	7.74	@	235	@	0.05	K	0.37	@
SALT RIVER AT SHEPHERDSVILLE		@		@		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE	61.6	@	11.6	@	2.31	@	6.29	@	202	@	0.05	K	0.85	@
SALT RIVER AT SHEPHERDSVILLE	62.2	@	8.9	@	2.8	@	3.06	@	192	@	0.05	@	1.64	@
SALT RIVER AT SHEPHERDSVILLE		@		@		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE	58.4	@	10.1	@	3.08	@	7.03	@	187	@	0.075	@	0.39	@
SALT RIVER AT SHEPHERDSVILLE		@		@		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE	50.1	@	14.5	@	4.43	@	12.3	@	185	@	0.094	@	1.2	@
SALT RIVER AT SHEPHERDSVILLE		@		@		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE		@		@		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE	45.8	@	12	@	4.15	@	14.8	@	164	@	0.05	K	0.72	@
SALT RIVER AT SHEPHERDSVILLE		@		@		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE	57.2	@	13.2	@	4.07	@	17.3	@	197	@	0.074	@	0.43	@

LOCATION	916		927		937		929		900		610		630	
	CALCIUM		MGNSIUM		PTSSIUM		SODIUM		TOT HARD		NH3+NH4-		NO2&NO3	
	CA-TOT		MG,TOT		K,TOT		NA,TOT		CACO3		N TOTAL		N-TOTAL	
	MG/L		MG/L		MG/L		MG/L		MG/L		MG/L		MG/L	
SALT RIVER AT SHEPHERDSVILLE	19	@	5.5	@	2.15	@	4.81	@	70	@	0.05	K	0.11	@
SALT RIVER AT SHEPHERDSVILLE	58.6	@	11	@	3.17	@	8.82	@	192	@	0.05	K	1.31	@
SALT RIVER AT SHEPHERDSVILLE	67.2	@	11.7	@	2.41	@	6.92	@	216	@	0.05	K	2.02	@
SALT RIVER AT SHEPHERDSVILLE	71.7	@	13.1	@	2.23	@	7.08	@	233	@	0.05	K	1.14	@
SALT RIVER AT SHEPHERDSVILLE	51	@	10.6	@	2.34	@	5.18	@	171	@	0.05	K	0.69	@
SALT RIVER AT SHEPHERDSVILLE	37.4	@	9.6	@	3.26	@	3.55	@	133	@	0.09	@	0.72	@
SALT RIVER AT SHEPHERDSVILLE	59.6	@	8.4	@	2.85	@	3.74	@	11	@	0.05	K	1.06	@
SALT RIVER AT SHEPHERDSVILLE		@		@		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE	57.2	@	12.5	@	3.7	@	6.42	@	194	@	0.05	K	0.75	@
SALT RIVER AT SHEPHERDSVILLE		@		@		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE		@		@		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE	44.8	@	10.1	@	4.49	@	9.68	@	153	@	0.05	K	0.6	@
SALT RIVER AT SHEPHERDSVILLE		@		@		@		@		@		@		@
SALT RIVER AT SHEPHERDSVILLE	52.9	@	8.8	@	3.18	@	6.05	@	168	@	0.05	K	1.13	@
ROLLING FORK NEAR LEBANON JUNCTION	47.4	@	9.4	@	3.97	@	3.85	@	157	@	0.05	K	0.95	@
ROLLING FORK NEAR LEBANON JUNCTION	59	@	12.6	@	2.84	@	4.03	@	199	@	0.05	K	1.29	@
ROLLING FORK NEAR LEBANON JUNCTION	53.9	@	14.5	@	3.19	@	5.44	@	194	@	0.05	K	0.72	@
ROLLING FORK NEAR LEBANON JUNCTION	57	@	11.6	@	2.52	@	4.59	@	190	@	0.05	K	1.31	@
ROLLING FORK NEAR LEBANON JUNCTION	61.9	@	12.8	@	1.79	@	5.02	@	207	@	0.05	K	1.32	@
ROLLING FORK NEAR LEBANON JUNCTION	44.8	@	10	@	3.38	@	3.49	@	153	@	0.05	@	0.71	@
ROLLING FORK NEAR LEBANON JUNCTION	59.9	@	12.3	@	2.24	@	3.51	@	200	@	0.052	@	1.01	@
ROLLING FORK NEAR LEBANON JUNCTION	45	@	9.2	@	3.32	@	2.15	@	150	@	0.05	K	0.96	@
ROLLING FORK NEAR LEBANON JUNCTION		@		@		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	43.1	@	8.1	@	3.63	@	2.95	@	141	@	0.05	K	1.21	@
ROLLING FORK NEAR LEBANON JUNCTION		@		@		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	44.6	@	9.9	@	4.11	@	4.51	@	152	@	0.05	K	0.53	@
ROLLING FORK NEAR LEBANON JUNCTION		@		@		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	53.3	@	10.1	@	4.19	@	4.83	@	175	@	0.113	@	0.68	@
ROLLING FORK NEAR LEBANON JUNCTION		@		@		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION		@		@		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	58.2	@	13.9	@	3.9	@	6.57	@	203	@	0.05	K	0.23	@
ROLLING FORK NEAR LEBANON JUNCTION	64.1	@	11.4	@	3.15	@	3.83	@	207	@	0.05	K	0.88	@
ROLLING FORK NEAR LEBANON JUNCTION	65.9	@	12.8	@	2.4	@	4.31	@	217	@	0.05	K	1.28	@
ROLLING FORK NEAR LEBANON JUNCTION	62	@	13.7	@	2.13	@	5.59	@	211	@	0.05	K	0.96	@
ROLLING FORK NEAR LEBANON JUNCTION	57.9	@	11.9	@	1.87	@	3.48	@	194	@	0.05	K	1.38	@

LOCATION	916		927		937		929		900		610		630	
	CALCIUM		MGNSIUM		PTSSIUM		SODIUM		TOT HARD		NH3+NH4-		NO2&NO3	
	CA-TOT		MG,TOT		K,TOT		NA,TOT		CACO3		N TOTAL		N-TOTAL	
	MG/L		MG/L		MG/L		MG/L		MG/L		MG/L		MG/L	
ROLLING FORK NEAR LEBANON JUNCTION	50.3	@	10.8	@	1.79	@	3.08	@	170	@	0.05	K	0.97	@
ROLLING FORK NEAR LEBANON JUNCTION	71.7	@	18.1	@	2.26	@	5.94	@	254	@	0.05	K	0.13	@
ROLLING FORK NEAR LEBANON JUNCTION		@		@		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	55.8	@	11.8	@	2.1	@	4.23	@	188	@	0.05	K	0.32	@
ROLLING FORK NEAR LEBANON JUNCTION	50.5	@	11.6	@	2.17	@	4.31	@	174	@	0.05	K	0.31	@
ROLLING FORK NEAR LEBANON JUNCTION	31.9	@	5.9	@	2.61	@	1.37	@	104	@	0.05	K	0.7	@
ROLLING FORK NEAR LEBANON JUNCTION	35.1	@	6.5	@	2.84	@	1.49	@	114	@	0.05	K	0.69	@
ROLLING FORK NEAR LEBANON JUNCTION		@		@		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	62.4	@	13.9	@	2.85	@	6.6	@	213	@	0.09	@	0.57	@
ROLLING FORK NEAR LEBANON JUNCTION		@		@		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	53.3	@	15.8	@	3.4	@	6.68	@	198	@	0.05	K	0.46	@
ROLLING FORK NEAR LEBANON JUNCTION		@		@		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION		@		@		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	64	@	16.8	@	3.71	@	11.9	@	229	@	0.079	@	0.25	@
ROLLING FORK NEAR LEBANON JUNCTION		@		@		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	73.2	@	17.5	@	3.74	@	15.2	@	255	@	0.201	@	0.05	@
ROLLING FORK NEAR LEBANON JUNCTION	53	@	14.3	@	3.67	@	10.8	@	191	@	0.05	K	0.41	@
ROLLING FORK NEAR LEBANON JUNCTION	55.5	@	11.4	@	2.58	@	4.51	@	186	@	0.05	K	1.94	@
ROLLING FORK NEAR LEBANON JUNCTION		@		@		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	55.5	@	11.4	@	2.58	@	4.51	@	186	@	0.05	K	1.94	@
ROLLING FORK NEAR LEBANON JUNCTION	64.9	@	13.4	@	2.23	@	5.12	@	217	@	0.05	K	1.5	@
ROLLING FORK NEAR LEBANON JUNCTION	55.8	@	12.1	@	1.9	@	4.21	@	189	@	0.05	K	0.67	@
ROLLING FORK NEAR LEBANON JUNCTION	38.1	@	11.4	@	3.05	@	3.56	@	142	@	0.058	@	0.42	@
ROLLING FORK NEAR LEBANON JUNCTION	53.5	@	17.4	@	4.03	@	3.37	@	205	@	0.096	@	0.38	@
ROLLING FORK NEAR LEBANON JUNCTION	39.2	@	7	@	3.23	@	1.86	@	127	@	0.05	K	0.17	@
ROLLING FORK NEAR LEBANON JUNCTION		@		@		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	53.6	@	12.9	@	4.18	@	6.52	@	187	@	0.055	@	0.63	@
ROLLING FORK NEAR LEBANON JUNCTION		@		@		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION		@		@		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	51	@	11.8	@	4.65	@	6.45	@	176	@	0.05	K	0.73	@
ROLLING FORK NEAR LEBANON JUNCTION		@		@		@		@		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	54.1	@	11.4	@	2.95	@	3.97	@	182	@	0.05	K	1.27	@

LOCATION	625		665		31616	
	TOT KJEL		PHOS-TOT		FEC COLI	
	N				MFM-FCBR	
	MG/L		MG/L P		/100ML	
SALT RIVER AT SHEPHERDSVILLE	0.735	@	0.25	@		@
SALT RIVER AT SHEPHERDSVILLE	0.675	@	0.116	@		@
SALT RIVER AT SHEPHERDSVILLE	0.602	@	0.232	@		@
SALT RIVER AT SHEPHERDSVILLE	1.02	@	0.431	@		@
SALT RIVER AT SHEPHERDSVILLE	0.464	@	0.108	@		@
SALT RIVER AT SHEPHERDSVILLE	0.679	@	0.117	@		@
SALT RIVER AT SHEPHERDSVILLE	0.869	@	0.233	@		@
SALT RIVER AT SHEPHERDSVILLE	0.368	@	0.114	@	660	@
SALT RIVER AT SHEPHERDSVILLE	0.889	@	0.348	@	220	@
SALT RIVER AT SHEPHERDSVILLE		@		@	1600	@
SALT RIVER AT SHEPHERDSVILLE	0.723	@	0.218	@		@
SALT RIVER AT SHEPHERDSVILLE		@		@	9600	@
SALT RIVER AT SHEPHERDSVILLE	0.75	@	0.17	@		@
SALT RIVER AT SHEPHERDSVILLE		@		@	10	@
SALT RIVER AT SHEPHERDSVILLE	0.623	@	0.191	@		@
SALT RIVER AT SHEPHERDSVILLE		@		@	200	@
SALT RIVER AT SHEPHERDSVILLE	0.709	@	0.193	@		@
SALT RIVER AT SHEPHERDSVILLE	0.482	@	0.108	@		@
SALT RIVER AT SHEPHERDSVILLE	0.725	@	0.101	@		@
SALT RIVER AT SHEPHERDSVILLE	0.504	@	0.127	@		@
SALT RIVER AT SHEPHERDSVILLE	0.499	@	0.257	@		@
SALT RIVER AT SHEPHERDSVILLE	0.48	@	0.304	@		@
SALT RIVER AT SHEPHERDSVILLE	0.594	@	0.115	@		@
SALT RIVER AT SHEPHERDSVILLE		@		@	350	@
SALT RIVER AT SHEPHERDSVILLE	0.379	@	0.113	@		@
SALT RIVER AT SHEPHERDSVILLE	1.07	@	0.394	@		@
SALT RIVER AT SHEPHERDSVILLE		@		@	2000	@
SALT RIVER AT SHEPHERDSVILLE	0.726	@	0.1	@		@
SALT RIVER AT SHEPHERDSVILLE		@		@	1700	@
SALT RIVER AT SHEPHERDSVILLE	0.552	@	0.141	@		@
SALT RIVER AT SHEPHERDSVILLE		@		@	140	@
SALT RIVER AT SHEPHERDSVILLE		@		@	20	@
SALT RIVER AT SHEPHERDSVILLE	0.626	@	0.098	@		@
SALT RIVER AT SHEPHERDSVILLE		@		@	220	@
SALT RIVER AT SHEPHERDSVILLE	0.295	@	0.081	@		@

LOCATION	625		665		31616	
	TOT KJEL		PHOS-TOT		FEC COLI	
	N				MFM-FCBR	
	MG/L		MG/L P		/100ML	
SALT RIVER AT SHEPHERDSVILLE	0.159	@	0.018	@		@
SALT RIVER AT SHEPHERDSVILLE	0.384	@	0.051	@		@
SALT RIVER AT SHEPHERDSVILLE	0.928	@	0.075	@		@
SALT RIVER AT SHEPHERDSVILLE	0.284	@	0.103	@		@
SALT RIVER AT SHEPHERDSVILLE	1.8	@	0.112	@		@
SALT RIVER AT SHEPHERDSVILLE	1.32	@	0.211	@		@
SALT RIVER AT SHEPHERDSVILLE	0.834	@	0.204	@		@
SALT RIVER AT SHEPHERDSVILLE		@		@	12000	@
SALT RIVER AT SHEPHERDSVILLE	0.617	@	0.09	@		@
SALT RIVER AT SHEPHERDSVILLE		@		@	110	@
SALT RIVER AT SHEPHERDSVILLE		@		@	50	@
SALT RIVER AT SHEPHERDSVILLE	0.551	@	0.142	@		@
SALT RIVER AT SHEPHERDSVILLE		@		@	1000	@
SALT RIVER AT SHEPHERDSVILLE	0.388	@	0.101	@		@
ROLLING FORK NEAR LEBANON JUNCTION	0.602	@	0.112	@		@
ROLLING FORK NEAR LEBANON JUNCTION	0.478	@	0.098	@		@
ROLLING FORK NEAR LEBANON JUNCTION	1.05	@	0.255	@		@
ROLLING FORK NEAR LEBANON JUNCTION	0.852	@	0.216	@		@
ROLLING FORK NEAR LEBANON JUNCTION	0.335	@	0.043	@		@
ROLLING FORK NEAR LEBANON JUNCTION	1.01	@	0.304	@		@
ROLLING FORK NEAR LEBANON JUNCTION	0.426	@	0.068	@	250	@
ROLLING FORK NEAR LEBANON JUNCTION	1.21	@	0.324	@	380	@
ROLLING FORK NEAR LEBANON JUNCTION		@		@	1100	@
ROLLING FORK NEAR LEBANON JUNCTION	1.56	@	0.19	@		@
ROLLING FORK NEAR LEBANON JUNCTION		@		@	250	@
ROLLING FORK NEAR LEBANON JUNCTION	0.829	@	0.109	@		@
ROLLING FORK NEAR LEBANON JUNCTION		@		@	170	@
ROLLING FORK NEAR LEBANON JUNCTION	1.86	@	0.534	@		@
ROLLING FORK NEAR LEBANON JUNCTION		@		@	120	@
ROLLING FORK NEAR LEBANON JUNCTION		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	0.334	@	0.079	@		@
ROLLING FORK NEAR LEBANON JUNCTION	0.334	@	0.078	@		@
ROLLING FORK NEAR LEBANON JUNCTION	0.175	@	0.068	@		@
ROLLING FORK NEAR LEBANON JUNCTION	1.01	@	0.156	@		@
ROLLING FORK NEAR LEBANON JUNCTION	0.204	@	0.075	@		@

LOCATION	625		665		31616	
	TOT KJEL		PHOS-TOT		FEC COLI	
	N				MFM-FCBR	
	MG/L		MG/L P		/100ML	
ROLLING FORK NEAR LEBANON JUNCTION	0.743	@	0.092	@		@
ROLLING FORK NEAR LEBANON JUNCTION	0.388	@	0.039	@		@
ROLLING FORK NEAR LEBANON JUNCTION		@		@	230	@
ROLLING FORK NEAR LEBANON JUNCTION	0.4	@	0.07	@		@
ROLLING FORK NEAR LEBANON JUNCTION	0.283	@	0.067	@		@
ROLLING FORK NEAR LEBANON JUNCTION	1.06	@	0.396	@		@
ROLLING FORK NEAR LEBANON JUNCTION	1.27	@	0.39	@		@
ROLLING FORK NEAR LEBANON JUNCTION		@		@	1400	@
ROLLING FORK NEAR LEBANON JUNCTION	0.899	@	0.112	@		@
ROLLING FORK NEAR LEBANON JUNCTION		@		@	30	@
ROLLING FORK NEAR LEBANON JUNCTION	0.539	@	0.01	@		@
ROLLING FORK NEAR LEBANON JUNCTION		@		@	240	@
ROLLING FORK NEAR LEBANON JUNCTION		@		@	30	@
ROLLING FORK NEAR LEBANON JUNCTION	0.283	@	0.068	@		@
ROLLING FORK NEAR LEBANON JUNCTION		@		@	110	@
ROLLING FORK NEAR LEBANON JUNCTION	0.458	@	0.067	@		@
ROLLING FORK NEAR LEBANON JUNCTION	0.764	@	0.059	@		@
ROLLING FORK NEAR LEBANON JUNCTION	0.684	@	0.039	@		@
ROLLING FORK NEAR LEBANON JUNCTION		@		@		@
ROLLING FORK NEAR LEBANON JUNCTION	0.684	@	0.039	@		@
ROLLING FORK NEAR LEBANON JUNCTION	0.236	@	0.055	@		@
ROLLING FORK NEAR LEBANON JUNCTION	0.386	@	0.085	@		@
ROLLING FORK NEAR LEBANON JUNCTION	1.51	@	0.316	@		@
ROLLING FORK NEAR LEBANON JUNCTION	1.99	@	0.419	@		@
ROLLING FORK NEAR LEBANON JUNCTION	0.821	@	0.418	@		@
ROLLING FORK NEAR LEBANON JUNCTION		@		@	1300	@
ROLLING FORK NEAR LEBANON JUNCTION	1.09	@	0.063	@		@
ROLLING FORK NEAR LEBANON JUNCTION		@		@	60	@
ROLLING FORK NEAR LEBANON JUNCTION		@		@	90	@
ROLLING FORK NEAR LEBANON JUNCTION	0.304	@	0.097	@		@
ROLLING FORK NEAR LEBANON JUNCTION		@		@	60	@
ROLLING FORK NEAR LEBANON JUNCTION	0.382	@	0.109	@		@

Appendix C
Output from FLUX Applications for the Salt River and Rolling Fork River Calculation of Loading Estimates for Total Nonfilterable Residue Concentrations

Salt River VAR=totnflt METHOD= 2 Q WTD C

COMPARISON OF SAMPLED AND TOTAL FLOW DISTRIBUTIONS

STR	NQ	NC	NE	VOL%	TOTAL FLOW	SAMPLED FLOW	C/Q SLOPE	SIGNIF
1	747	22	22	15.5	466.690	474.880	.357	.027
2	429	13	13	84.5	4438.523	3449.683	.558	.469
***	1176	35	35	100.0	1915.598	1579.807		

FLOW STATISTICS
FLOW DURATION = 1176.0 DAYS = 3.220 YEARS
MEAN FLOW RATE = 1915.598 HM3/YR
TOTAL FLOW VOLUME = 6167.68 HM3
FLOW DATE RANGE = 19951012 TO 19981230
SAMPLE DATE RANGE = 19951012 TO 19981217

METHOD	MASS (KG)	FLUX (KG/YR)	FLUX VARIANCE	CONC (PPB)	CV
1 AV LOAD	413168300.0	128324600.0	.8377E+15	66989.29	.226
2 Q WTD C	521698600.0	162032700.0	.1050E+16	84585.92	.200
3 IJC	523557000.0	162609900.0	.1021E+16	84887.23	.197
4 REG-1	595510300.0	184957600.0	.1781E+16	96553.43	.228
5 REG-2	808612100.0	251144200.0	.3420E+17	131104.80	.736
6 REG-3	638657700.0	198358600.0	.2560E+16	103549.20	.255

Salt River VAR=totnflt METHOD= 2 Q WTD C

FLUX Breakdown by Stratum:

ST	NS	NE	FREQ DAYS	FLOW HM3/YR	FLUX KG/YR	VOLUME HM3	MASS KG	CONC PPB	CV -
1	22	22	747.0	466.69	15658980.0	954.46	32025350.0	33553.3	.388
2	13	13	429.0	4438.52	416907100.0	5213.21	489673200.0	93929.2	.212
***	35	35	1176.0	1915.60	162032700.0	6167.68	521698600.0	84585.9	.200

Optimal Sample Allocation:

ST	NS	NE	NE%	NEOPT%	FREQ%	VOL%	MASS%	VAR%	VARIANCE	CV
1	22	22	62.9	13.5	63.5	15.5	6.1	1.4	.1490E+14	.388
2	13	13	37.1	86.5	36.5	84.5	93.9	98.6	.1035E+16	.212
***	35	35	100.0	100.0	100.0	100.0	100.0	100.0	.1050E+16	.200

Optimal Allocation of 35 Sampled Events Across Strata (According to NEOPT%)
Would Reduce CV of FLUX Estimate from .200 to .140

```
Rolling Fork                              VAR=totnflt    METHOD= 2 Q WTD C
COMPARISON OF SAMPLED AND TOTAL FLOW DISTRIBUTIONS
STR          NQ  NC  NE   VOL%   TOTAL FLOW SAMPLED FLOW   C/Q SLOPE SIGNIF
 1          889  28  28   21.2      579.034      632.101        .225   .285
 2          287   6   6   78.8     6647.074     7280.676      -1.160   .303
***        1176  34  34  100.0     2059.925     1805.379

FLOW STATISTICS
FLOW DURATION =      1176.0 DAYS  =   3.220 YEARS
MEAN FLOW RATE =   2059.925 HM3/YR
TOTAL FLOW VOLUME =      6632.37 HM3
FLOW DATE RANGE    = 19951012 TO 19981230
SAMPLE DATE RANGE = 19951012 TO 19981217

METHOD            MASS (KG)      FLUX (KG/YR)    FLUX VARIANCE CONC (PPB)      CV
1 AV LOAD     2499837000.0      776416200.0        .8780E+17  376914.80     .382
2 Q WTD C     2282719000.0      708982200.0        .1053E+18  344178.70     .458
3 IJC         2110852000.0      655602500.0        .6776E+17  318265.30     .397
4 REG-1       2520173000.0      782732300.0        .1889E+18  379981.00     .555
5 REG-2       2624965000.0      815279300.0        .1758E+18  395781.10     .514
6 REG-3       4386940000.0     1362525000.0        .1281E+19  661444.30     .831


Rolling Fork                              VAR=totnflt    METHOD= 2 Q WTD C

FLUX Breakdown by Stratum:

                  FREQ         FLOW          FLUX       VOLUME          MASS        CONC       CV
ST   NS   NE      DAYS        HM3/YR         KG/YR        HM3             KG         PPB        -
 1   28   28     889.0       579.03 52759060.0       1409.34 128412900.0   91115.6    .314
 2    6    6     287.0      6647.07***********       5223.032154306000.0 412463.2    .485
***  34   34    1176.0      2059.92708982200.0       6632.372282719000.0 344178.7    .458

Optimal Sample Allocation:

ST       NS       NE      NE% NEOPT%   FREQ%    VOL%   MASS%    VAR%     VARIANCE     CV
 1       28       28     82.4     7.7    75.6    21.2     5.6      .1    .1567E+15   .314
 2        6        6     17.6    92.3    24.4    78.8    94.4    99.9    .1052E+18   .485
***      34       34    100.0   100.0   100.0   100.0   100.0   100.0    .1053E+18   .458

Optimal Allocation of    34 Sampled Events Across Strata (According to NEOPT%)
Would Reduce CV of FLUX Estimate from    .458 to    .208
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12b.DISTRIBUTION CODE

13.ABSTRACT ***(Maximum 200 words)***

New training facilities have been proposed for construction at the Fort Knox Northern Training Complex. These facilities include a digital training range and a complex of drop/landing zones and a maneuver area. During review of an Environmental Assessment, concerns about sediment erosion and adverse water quality impacts from the construction and project were expressed. Assessments of existing water quality data and the potential for sediment erosion were conducted to address potential impacts. Water quality data collected from 1995 to 1998 near the study area at the two major rivers, onsite data collected for discharge permit monitoring, data retrieved from the U.S. Environmental Protection Agency Storage and Retrieval system (STORET), and real-time discharge data were available for assessing existing conditions. Material loading was estimated using water quality and discharge data. Sediment yield for the preproject and postproject conditions for each alternative was conducted using the Revised Universal Soil Loss Equation, soil characteristics, and terrain slope developed from digital terrain elevation data. Water quality constituents generally fell within acceptable concentration ranges although total phosphorus concentrations were well above concentration guidelines used for lakes and reservoirs (0.02 mg L^{-1}), and elevated concentrations of solids, nutrients, and fecal coliform were most commonly observed with runoff events. Loading estimates indicated that sediment loads in the Salt River were about four times higher than in the Rolling Fork River.

(Continued)

14.SUBJECT TERMS

Fort Knox	Sediment erosion
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Salt River	

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Sediment yield estimates were highest for the construction period but accounted for less than 0.2 percent of the annual load from each training area alternative to the corresponding receiving stream using preproject and postproject estimates. During construction, sediment yield estimates accounted for 4-10 percent of the annual load at most sites and near 20-40 percent at three sites, when no erosion control measures were considered, and provided a worst-case scenario. Actual loads were anticipated to be lower with the implementation of best management practices.